PB-240 032

RADIOLOGICAL HEALTH DATA. VOLUME 1, NUMBERS 4-6, JULY-SEPTEMBER 1960

Public Health Service
Washington, D. C.

September 1960

DISTRIBUTED BY:

NTIS
National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

BIBLIOGRAPHIC DATA SHEET	1. Report No. RHD 1 (4-6)	2.	PB 240 032

4. Title and Subtitle Radiological Health Data Volume 1, Nos 4-6	5. Report Date July-Sept 1960
	6.
7. Author(s) None	8. Performing Organization Rept. No.
9. Performing Organization Name and Address U.S. Department of Health, Education, and Welfare Public Health Service Washington, D. C. 20201	10. Project/Task/Work Unit No.
	11. Contract/Grant No.
12. Sponsoring Organization Name and Address U.S. Environmental Protection Agency Office of Radiation Programs 401 M St., S. W. Washington, D. C. 20460	13. Type of Report & Period Covered Final: July-Sept 1960
	14.

15. Supplementary Notes

16. Abstracts

Data and interpretation of data on radiation exposure to humans and on radioactivity in milk, water, air, and other environmental media are presented.

17. Key Words and Document Analysis. 17a. Descriptors

Radiation
Radioactivity
Air
Water
Milk
Food
Human

17b. Identifiers/Open-Ended Terms

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
US Department of Commerce
Springfield, VA. 22151

PRICES SUBJECT TO CHANGE

17c. COSATI Field/Group

18. Availability Statement Release unlimited	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 232
1<	20. Security Class (This Page UNCLASSIFIED	22. Price 7.50 / MF 2.25

RADIOLOGICAL HEALTH DATA

QUARTERLY REPORT

JULY 1960

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

Division of Radiological Health

PREFACE

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned, among other things, primary responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. Within the Department this responsibility has been delegated to the Division of Radiological Health, Public Health Service.

As a step in the discharge of this responsibility, the Public Health Service is publishing ***Radiological Health Data***. This publication is issued monthly, with each third issue expanded somewhat into a quarterly report. This July 1960 issue is the first quarterly report.

The monthly and quarterly reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
Department of Commerce
Department of Agriculture

TABLE OF CONTENTS

Page
PREFACE ii

SECTION I.—RADIATION PROTECTION CRITERIA 1

SECTION II.—MILK 7
  Description of Public Health Service Milk Monitoring Program 7
  Data on Radioactivity in Milk (February 1960)—Public Health Service Milk Monitoring Program 9
  Average and Maximum Annual Concentration of Strontium-90 in Milk—United States (1957-59)—Public Health Service Milk Monitoring Program 10
  Radionuclide (Short-lived and Long-lived) Concentration in Milk—Public Health Service Milk Monitoring Program 12
  Minnesota Milk Data (September 1958 to December 1959)—Department of Health of the State of Minnesota 32

SECTION III.—AIR 33
  Description of Public Health Service Radiation Surveillance Network 33
  Data on Radioactivity of Particulates in Air—Gross Beta Counts (February 1960)—Public Health Service Radiation Surveillance Network 35
  Beta Activity of Air-borne Particulates (Inauguration of program through December 1959)—Public Health Service Radiation Surveillance Network 36
  Data on Radon and Thoron Air Measurements at Cincinnati, Ohio (February 1960)—Public Health Service Radiation Surveillance Network 80
  Average Measurements of Surface Air at 14 Stations Along 80th Meridian (March 1960)—U. S. Naval Research Laboratory 80

SECTION IV.—WATER 84
  Description of Public Health Service National Water Quality Network 84
  Data on Radioactivity in Raw Surface Waters (January 1960)—Public Health Service National Water Quality Network 86
  Data on Strontium-90 in New York City Tap Water (December 1959)—Health and Safety Laboratory—U. S. Atomic Energy Commission 88
  Data on Strontium-90 Determinations on Cistern Water Composites—Public Health Service 88

SECTION V.—OTHER DATA 89
  Human Bone:
    Strontium-90 Activity in Human Bone From St. Louis, Missouri Area—Public Health Service 89
  Food:
    Data on Radiochemical Analyses of Food—Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio 93
  Fish:
    Data on Radioactivity in Fish—Minnesota Department of Conservation 97
  Soils:
    Fission Products Radioactivity in Soil at Argonne National Laboratory—U. S. Atomic Energy Commission 99
  External Gamma:
    Data of External Gamma Activity (February 1960)—Public Health Service Radiation Surveillance Network 106
  Atomic Power Station:
    Summary of Environmental Radioactivity at the Shippingport Atomic Power Station for the Calendar Year 1959—U. S. Atomic Energy Commission 107

LIST OF TABLES

I.—Radiation Protection Guides 3
II.—Wheat Milling Products (1958 Crop)—U. S. Atomic Energy Commission 5

LIST OF TABLES—Con.

Page
III.—Comparative Consumption of Strontium-90 in an Average Diet 6
IV.—Radioactivity in Milk (February 1960)—Public Health Service Milk Monitoring Program...... 9
V.—Strontium-90 in Milk Collected at Seven Locations in Minnesota (September 1958 to December 1959)—Department of Health of the State of Minnesota 32
VI.—Radioactivity of Particulates in Air—Gross Beta Counts (February 1960)—Public Health Service Radiation Surveillance Network 35
VII.—Radon and Thoron Air Measurements (February 1960)—Public Health Service Radiation Surveillance Network 80
VIII.—Daily Record of Fission Product β-Activity Collected by Air Filtration—U. S. Naval Research Laboratory 81
IX.—Radioactivity in Raw Surface Waters (January 1960)—Public Health Service National Water Quality Network 86
X.—Strontium-90 in New York City Tap Water (December 1959) Health and Safety Laboratory—U. S. Atomic Energy Commission 88
XI.—Strontium-90 Analyses on Cistern Water Composites (October, November and December 1959)—Public Health Service 88
XII.—Strontium-90 Analyses—Human Bone Samples From St. Louis, Missouri Area—Public Health Service 90
XIII.—Summary St. Louis Human Bone Data (Strontium-90)—Public Health Service 92
XIV.—Comparison of Strontium-90 Activity in Human Bones of St. Louis Area and North America 92
XV.—Calcium and Strontium-90 Content of Foods (Cincinnati, Ohio)—Public Health Service 93
XVI.—Calcium, Potassium, Gross Beta and Specific Radionuclide Content of Foods (Cincinnati, Ohio)—Public Health Service 94
XVII.—Calcium and Strontium-90 Content of Meals—Lunches (Cincinnati, Ohio)—Public Health Service 95
XVIII.—Calcium and Strontium-90 Content of Meals—Breakfasts (Cincinnati, Ohio)—Public Health Service 96
XIX.—Strontium-90 Analysis of Cereals (Purchased at Cincinnati, Ohio)—Public Health Service.... 97
XX.—Strontium-90 Levels in Minnesota Fish—Minnesota Department of Conservation 98
XXI.—Fission Product Radioactivity in Soil at Argonne National Laboratory.......... 106
XXII.—External Gamma Activity (February 1960)—Public Health Service Radiation Surveillance Network 106

LIST OF FIGURES

Figures 1-2. Average and Maximum Annual Concentration of Strontium-90 in Milk—United States (1957-59)—Public Health Service Milk Monitoring Program 10-11
Figures 3-22. Short-lived and Long-lived Radionuclide Concentration in Milk—United States (1957-59)—Public Health Service Milk Monitoring Program..........12-31
Figure 23. Public Health Service Radiation Surveillance Network Sampling Stations 34
Figures 24-67. Beta Activity of Air-Borne Particulates—Public Health Service Radiation Surveillance Network 36-79
Figure 68. Average Measurements of Surface Air at 14 Stations Along 80th Meridian (March 1960)—U. S. Naval Research Laboratory.......... 83
Figure 69. Public Health Service National Water Quality Network of Sampling Stations 85
Figures 70-75. Fission Products Radioactivity in Soil at Argonne National Laboratory—U. S. Atomic Energy Commission..........100-105

5<

SECTION I

RADIATION PROTECTION CRITERIA

During May and June there were two significant developments in the field of radiation protection criteria. One, the Special Radiation Subcommittee of the Joint (Congressional) Committee on Atomic Energy held a set of Hearings "Radiation Protection Criteria and Standards: Their Basis and Uses." A preprint of relevant materials was published in May 1960.* Publication of the testimony at the Hearings will be made in the fall of 1960.

Second, the first report of the Federal Radiation Council was released in the form of a memorandum to The President together with a 39 page document entitled Background Material for the Development of Radiation Protection Standards,** (May 13, 1960. The recommendations contained in the memorandum were approved by The President on May 13, 1960 and published in the Federal Register on May 18, 1960. The text of this memorandum is reproduced below.

The Radiation Protection Guides contained in the approved memorandum ". . . do not differ substantially from certain other recommendations such as those made by the National Committee on Radiation Protection and Measurement, the National Academy of Sciences, and the International Commission on Radiological Protection . . . ." These Guides are ". . . for the guidance of Federal agencies . . ." It is anticipated that appropriate Federal agencies will adopt standards and criteria within the framework of these broad guides.

Recognizing the need for further study of standards and criteria for internal emitters, the Federal Radiation Council has organized a full time temporary staff to prepare a report on this aspect of radiation criteria. Since this study has just been initiated, no time for completion has been set but it is anticipated that the report will be released before the end of the year.

During this period of intensive study of radiation protection criteria, the Department of Health, Education, and Welfare is using as a guideline in evaluating the strontium-90 (the principal isotope of concern) content of foodstuffs, a daily intake of 73 micromicrocuries for the general population. Individuals' diet may depart from this guideline by as much as three times over that for the general population value. Both guidelines refer to the strontium-90 content of the entire diet, averaged over a period of one year. They are not mandatory limits for regulatory action but rather guides in evaluating situations as they arise. This procedure of evaluation is illustrated in the press release of Arthur S. Flemming, Secretary of Health, Education, and Welfare, April 28, 1960 concerning the strontium-90 content of wheat. Secretary Flemming's statement is reproduced below.

FOR RELEASE IN A. M. PAPERS OF TUESDAY, MAY 17, 1960

A. Wayne Hawks, Acting Assistant Press Secretary

THE WHITE HOUSE

THE WHITE HOUSE TODAY MADE PUBLIC THE FOLLOWING MEMORANDUM TO THE PRESIDENT FROM THE CHAIRMAN OF THE FEDERAL RADIATION COUNCIL. THE PRESIDENT APPROVED RECOMMENDATIONS NUMBERED 1 THROUGH 7 OF THE MEMORANDUM FOR THE GUIDANCE OF FEDERAL AGENCIES.

MEMORANDUM FOR THE PRESIDENT

SUBJECT: Radiation Protection Guidance for Federal Agencies

---

*Selected Materials on Radiation Protection Criteria and Standards: Their Basis and Uses. Joint Committee on Atomic Energy, Congress of the United States. May 1960. Government Printing Office, Washington, D. C. ($3.25)

**To be for sale by the Superintendent of Documents, Washington, D. C.

Pursuant to Executive Order 10831 and Public Law 86-373, the Federal Radiation Council has made a study of the hazards and use of radiation. We herewith transmit our first report to you concerning our findings and our recommendations for the guidance of Federal agencies in the conduct of their radiation protection activities.

It is the statutory responsibility of the Council to ". . . advise the President with respect to radiation matters, directly or indirectly affecting health, including guidance for all Federal agencies in the formulation of radiation standards and in the establishment and execution of programs of cooperation with States . . ."

Fundamentally, setting basic radiation protection standards involves passing judgment on the extent of the possible health hazard society is willing to accept in order to realize the known benefits of radiation. It involves inevitably a balancing between total health protection, which might require foregoing any activities increasing exposure to radiation, and the vigorous promotion of the use of radiation and atomic energy in order to achieve optimum benefits.

The Federal Radiation Council has reviewed available knowledge on radiation effects and consulted with scientists within and outside the Government. Each member has also examined the guidance recommended in this memorandum in light of his statutory responsibilities. Although the guidance does not cover all phases of radiation protection, such as internal emitters, we find that the guidance which we recommend that you provide for the use of Federal agencies gives appropriate consideration to the requirements of health protection and the beneficial uses of radiation and atomic energy. Our further findings and recommendations follow.

Discussion. The fundamental problem in establishing radiation protection guides is to allow as much of the beneficial uses of ionizing radiation as possible while assuring that man is not exposed to undue hazard. To get a true insight into the scope of the problem and the impact of the decisions involved, a review of the benefits and the hazards is necessary.

It is important in considering both the benefits and hazards of radiation to appreciate that man has existed throughout his history in a bath of natural radiation. This background radiation, which varies over the earth, provides a partial basis for understanding the effects of radiation on man and serves as an indicator of the ranges of radiation exposures within which the human population has developed and increased.

The benefits of ionizing radiation. Radiation properly controlled is a boon to mankind. It has been of inestimable value in the diagnosis and treatment of diseases. It can provide sources of energy greater than any the world has yet had available. In industry, it is used as a tool to measure thickness, quantity or quality, to discover hidden flaws, to trace liquid flow, and for other purposes. So many research uses for ionizing radiation have been found that scientists in many diverse fields now rank radiation with the microscope in value as a working tool.

The hazards of ionizing radiation. Ionizing radiation involves health hazards just as do many other useful tools. Scientific findings concerning the biological effects of radiation of most immediate interest to the establishment of radiation protection standards are the following:

1. Acute doses of radiation may produce immediate or delayed effects, or both.

2. As acute whole body doses increase above approximately 25 rems (units of radiation dose), immediately observable effects increase in severity with dose, beginning from barely detectable changes, to biological signs clearly indicating damage, to death at levels of a few hundred rems.

3. Delayed effects produced either by acute irradiation or by chronic irradiation are similar in kind, but the ability of the body to repair radiation damage is usually more effective in the case of chronic than acute irradiation.

4. The delayed effects from radiation are in general indistinguishable from familiar pathological conditions usually present in the population.

5. Delayed effects include genetic effects (effects transmitted to succeeding generations), increased incidence of tumors, lifespan shortening, and growth and development changes.

6. The child, the infant, and the unborn infant appear to be more sensitive to radiation than the adult.

7. The various organs of the body differ in their sensitivity to radiation.

8. Although ionizing radiation can induce genetic and somatic effects (effects on the individual during his lifetime other than genetic effects), the evidence at the present time is insufficient to justify precise conclusions on the nature of the dose-effect relationship at low doses and dose rates. Moreover, the evidence is insufficient to prove either the hypothesis of a "damage threshold" (a point below which no damage occurs) or the hypothesis of "no threshold" in man at low doses.

7<

9. If one assumes a direct linear relation between biological effect and the amount of dose, it then becomes possible to relate very low dose to an assumed biological effect even though it is not detectable. It is generally agreed that the effect that may actually occur will not exceed the amount predicted by this assumption.

Basic biological assumptions. There are insufficient data to provide a firm basis for evaluating radiation effects for all types and levels of irradiation. There is particular uncertainty with respect to the biological effects at very low doses and low-dose rates. It is not prudent therefore to assume that there is a level of radiation exposure below which there is absolute certainty that no effect may occur. This consideration, in addition to the adoption of the conservative hypothesis of a linear relation between biological effect and the amount of dose, determines our basic approach to the formulation of radiation protection guides.

The lack of adequate scientific information makes it urgent that additional research be undertaken and new data developed to provide a firmer basis for evaluating biological risk. Appropriate member agencies of the Federal Radiation Council are sponsoring and encouraging research in these areas.

Recommendations. In view of the findings summarized above the following recommendations are made:

It is recommended that:

1. There should not be any man-made radiation exposure without the expectation of benefit resulting from such exposure. Activities resulting in man-made radiation exposure should be authorized for useful applications provided in recommendations set forth herein are followed.

It is recommended that:

2. The term "Radiation Protection Guide" be adopted for Federal use. This term is defined as the radiation dose which should not be exceeded without careful consideration of the reasons for doing so; every effort should be made to encourage the maintenance of radiation doses as far below this guide as practicable.

It is recommended that:

3. The following Radiation Protection Guides be adopted for normal peacetime operations:

TABLE I

Type of exposure	Condition	Dose (rem)
Radiation worker:		
(a) Whole body, head and trunk, active blood forming organs, gonads, or lens of eye.	Accumulated dose...	5 times the number of years beyond age 18.
	13 weeks..............	3.
(b) Skin of whole body and thyroid.......................	Year.....................	30.
	13 weeks..............	10.
(c) Hands and forearms, feet and ankles..............	Year.....................	75.
	13 weeks..............	25.
(d) Bone..	Body burden...........	0.1 microgram of radium-226 or its biological equivalent.
(c) Other organs	Year.....................	15.
	13 weeks..............	5.
Population:		
(a) Individual..	Year.....................	0.5 (whole body).
(b) Average..	30 year.................	5 (gonads).

The following points are made in relation to the Radiation Protection Guides herein provided:

(1) For the individual in the population, the basic Guide for annual whole body dose is 0.5 rem. This Guide applies when the individual whole body doses are known. As an operational technique, where the individual whole body doses are not known, a suitable sample of the exposed population should be developed whose protection guide for annual whole body dose will be 0.17 rem per capita per year. It is emphasized that this is an operational technique which should be modified to meet special situations.

(2) Considerations of population genetics impose a per capita dose limitation for the gonads of 5 rems in 30 years. The operational mechanism described above for the annual individual whole body dose of 0.5 rem is likely in the immediate future to assure that the gonadal exposure Guide (5 rem in 30 years) is not exceeded.

(3) These Guides do not differ substantially from certain other recommendations such as those made by the National Committee on Radiation Protection and Measurements, the National Academy of Sciences, and the International Commission on Radiological Protection.

(4) The term "maximum permissible dose" is used by the National Committee on Radiation Protection (NCRP) and the International Commission on Radiological Protection (ICRP). However, this term is often misunderstood. The words "maximum" and "permissible" both have unfortunate connotations not intended by either the NCRP or the ICRP.

(5) There can be no single permissible or acceptable level of exposure without regard to the reason for permitting the exposure. It should be general practice to reduce exposure to radiation, and positive effort should be carried out to fulfill the sense of these recommendations. It is basic that exposure to radiation should result from a real determination of its necessity.

(6) There can be different Radiation Protection Guides with different numerical values, depending upon the circumstances. The Guides herein recommended are appropriate for normal peacetime operations.

(7) These Guides are not intended to apply to radiation exposure resulting from natural background or the purposeful exposure of patients by practitioners of the healing arts.

(8) It is recognized that our present scientific knowledge does not provide a firm foundation within a factor of two or three for selection of any particular numerical value in preference to another value. It should be recognized that the Radiation Protection Guides recommended in this paper are well below the level where biological damage has been observed in humans.

It is recommended that:

4. Current protection guides used by the agencies be continued on an interim basis for organ doses to the population.

Recommendations are not made concerning the Radiation Protection Guides for individual organ doses to the population, other than the gonads. Unfortunately, the complexities of establishing guides applicable to radiation exposure of all body organs preclude the Council from making recommendations concerning them at this time. However, current protection guides used by the agencies appear appropriate on an interim basis.

It is recommended that:

5. The term "Radioactivity Concentration Guide" be adopted for Federal use. This term is defined as the concentration of radioactivity in the environment which is determined to result in whole body or organ doses equal to the Radiation Protection Guide.

Within this definition, Radioactivity Concentration Guides can be determined after the Radiation Protection Guides are decided upon. Any given Radioactivity Concentration Guide is applicable only for the circumstances under which the use of its corresponding Radiation Protection Guide is appropriate.

It is recommended that:

6. The Federal agencies, as an interim measure, use radioactivity concentration guides which are consistent with the recommended Radiation Protection Guides. Where no Radiation Protection Guides are provided, Federal agencies continue present practices.

No specific numerical recommendations for Radioactivity Concentration Guides are provided at this time. However, concentration guides now used by the agencies appear appropriate on an interim basis. Where appropriate radioactivity concentration guides are not available, and where Radiation Protection Guides for specific organs are provided herein, the latter Guides can be used by the Federal agencies as a starting point for the derivation of radioactivity concentration guides applicable to their particular problems. The Federal Radiation Council has also initiated action directed towards the development of additional Guides for radiation protection.

It is recommended that:

7. The Federal agencies apply these Radiation Protection Guides with judgment and discretion, to assure that reasonable probability is achieved in the attainment of the desired goal of protecting man from the undesirable effects of radiation. The Guides may be exceeded only after the Federal agency

having jurisdiction over the matter has carefully considered the reason for doing so in light of the recommendations in this paper.

The Radiation Protection Guides provide a general framework for the radiation protection requirements. It is expected that each Federal agency, by virtue of its immediate knowledge of its operating problems, will use these Guides as a basis upon which to develop detailed standards tailored to meet its particular requirements. The Council will follow the activities of the Federal agencies in this area and will promote the necessary coordination to achieve an effective Federal program.

If the foregoing recommendations are approved by you for the guidance of Federal agencies in the conduct of their radiation protection activities, it is further recommended that this memorandum be published in the FEDERAL REGISTER.

ARTHUR S. FLEMMING,
Chairman, Federal Radiation Council

The recommendations numbered "1" through "7" contained in the above memorandum are approved for the guidance of Federal agencies, and the memorandum shall be published in the FEDERAL REGISTER.

DWIGHT D. EISENHOWER

May 13, 1960.

STATEMENT*

By Arthur S. Flemming
Secretary of Health, Education, and Welfare

I have been provided with a copy of the regular quarterly statement of the Atomic Energy Commission on fallout, which is being released today. This statement contains information relating to the strontium 90 content of wheat and wheat products from the 1958 crop in 9 States.

At my request, the Public Health Service, the Food and Drug Administration, and the Federal Radiation Council have reviewed these data.

The advice given me by the Public Health Service and the Food and Drug Administration, which has been concurred in by the Federal Radiation Council and which I have accepted, is that the strontium 90 intake of the U. S. population from all dietary sources at the present time does not constitute a public health hazard warranting any regulatory action.

The data contained in the Atomic Energy Commission statement are summarized in the table below:

TABLE II.—WHEAT MILLING PRODUCTS—1958 CROP FROM 9 STATES (STRONTIUM 90 IN MICROMICROCURIES[1] PER KILOGRAM)

Reported by the Atomic Energy Commission, April 1960

Material	Strontium 90 micromicrocuries per kilogram		
	Low	High	Average
Wheat	21	133	62
Patent flour	3	42	12
1 and 2 clear flour	6	86	28
Germ	50	191	
Shorts	28	665	
Bran	52	675	231

[1] A curie is a measure of radioactivity equivalent to that produced by 1 gram of radium. A micromicrocurie is one millionth of a millionth of a curie.

---

*Issued at Briefing Conference, Washington, D. C., Wednesday, April 27, 1960.

The Statement of the Atomic Energy Commission also shows that up to the present time analyses on the 1959 crop have been completed for whole wheat only. These analyses show results similar to those for the 1958 crop.

The conclusion that the present situation does not call for any regulatory action was based on the following considerations:

A. The guideline for average daily intake of strontium 90 used by this Department at present is 33 micromicrocuries per liter or kilogram of total dietary intake averaged over a period of one year. This value is derived from the recent interim recommendation of the National Committee on Radiation Protection and Measurements that the values suggested by the International Commission on Radiation Protection for planning purposes be accepted. Although this guideline was not developed to serve as a limit for regulatory purposes, it is a conservative basis for evaluating the significance of these data. For general populations the International Commission on Radiation Protection suggested 33 micromicrocuries per liter or kilogram based upon a 50-year exposure, but for operating purposes averaged over periods not to exceed one year. This value applies to all groups within the population. In considering the health effects of strontium 90 it is necessary to take into account the amounts ingested from all sources. The average weight of food and water ingested per day per individual in the U. S. is 2.2 kilograms. If all the food and water contained this concentration of 33 micromicrocuries per kilogram, then the daily intake of strontium 90 would be 73 micromicrocuries (2.2x33).

B. The following diet shows how the wheat data reported by the Atomic Energy Commission would be reflected in a typical adult diet. This diet is adapted from one that was presented by the Public Health Service at hearings of the Joint Committee on Atomic Energy last year. An estimated average daily consumption of 1.8 grams of bran, as estimated by the U. S. Department of Agriculture, was added to this diet (rounded in the table to 2.0 grams). The strontium 90 values for bran and flour products in this diet are the average values of the Atomic Energy Commission report. The strontium 90 values for other items of this diet are considered typical for a large metropolitan area.

TABLE III.—COMPARATIVE CONSUMPTION OF STRONTIUM 90 IN AN AVERAGE DIET OF 2,200 GRAMS PER DAY

(A gram is $\frac{1}{1,000}$ of a kilogram or $\frac{1}{28.35}$ of an ounce.)

	Strontium 90 content micromicrocuries per gram	Food consumption in grams per day	Strontium 90 micromicrocuries per day
Bran	.231	2.0	0.4
Flour products	.012	227	2.7
Foods other than milk, water, and wheat products	.004	971	3.9
Milk and milk products	.010	410	4.1
Water and other non-milk fluids	.001	590	1.0
Total		2,200	12.1

C. The averages were used in the above table because the National Committee on Radiation Protection and the International Commission on Radiation Protection recommendations are for general population averages. It is, however, necessary to consider individual variations from the average involving the known deviations in concentrations of strontium 90 from the average and individual variations in dietary habits. In calculating the guidelines for specific averages the National Committee on Radiation Protection and the International Commission on Radiation Protection recommendations allow departures as much as 3 times such averages. In a given case this could be equivalent to an individual lifetime average of 220 micromicrocuries of strontium 90 per day.

I have had my staff calculate the strontium 90 content of various probable diets under the varying concentrations of strontium 90 reported by the Atomic Energy Commission. The conclusion was it would be highly improbable that any individual could attain an average of 73 micromicrocuries of strontium 90 per day for life, let alone the higher figure of 220 micromicrocuries.

* * * * * *

NOTE: The 9 States referred to in the opening paragraph of this statement are: Minnesota, North Dakota, Montana, Illinois, Kansas, Oklahoma, Texas, Michigan, and New York.

11<

SECTION II

MILK

PUBLIC HEALTH SERVICE MILK MONITORING PROGRAM

The U. S. Public Health Service Milk Monitoring Network presently consists of 12 sampling stations. This will be expanded to about 60 stations by the summer of 1960.

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Department of Health, Education, and Welfare to determine trends in our changing environment, including measurement of amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing since it is among the most important elements of the diet and is constantly available at all seasons of the year and in all climates. A primary objective of the project was to develop and simplify methods of collection and radiochemical analysis of milk to make them more suitable for larger scale programs.

The selection of the present 12 sampling stations was based on the following criteria:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.

2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.

3. The milk samples were from a supply that was part of a metropolitan milkshed.

4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

The Overton, Nevada and St. George, Utah milksheds do not fulfill the 1,000 cow minimum requirement but have been included since they are part of the monitoring program around the Nevada Test Site.

One gallon samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, for radionuclide analysis. It is estimated that these samples represent 2,000 gallon lots. The concentration of iodine-131, barium-140, and cesium-137 and naturally occurring potassium-40 are all currently being measured when present in the milk by gamma scintillation spectroscopy. Total strontium and strontium-90 are determined following radiochemical separations, and the strontium-90 is calculated by measuring the build-up of the daughter decay product, yttrium-90 (after about a two week wait) using a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference.

Publication of the data will normally require a period of about four months after collection due to shipment, processing, decay product build-up, compilation of the data, and inclusion with other radiation data in the monthly reports.

Concentrations of radionuclides in milk at all stations since mid-1957 are shown in figures 1 through 22.

A description of the program appears in "The Occurrence of Strontium-90, Iodine-131 and Other Radionuclides in Milk, May 1957 through April 1958," by J. E. Campbell, G. K. Murthy, A. S. Goldin, H. B. Robinson, C. P. Straub, F. J. Weber, and K. H. Lewis, American Journal of Public Health, Vol. 49, No. 2, Feb. 1959, American Public Health Association, reprinted by the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959.

Detailed technical descriptions of the methodology of analyses are listed below:

"Determination of I-131, Cs-137 and Ba-140 in Fluid Milk by Gamma Spectroscopy." By G. R. Hagee, G. R. Karches and A. S. Goldin, Public Health Service.

"A Method for the Rapid Ashing of Milk for Radionuclide Analysis," Journal of Dairy Science, 42-1288, Aug. 1959. By G. K. Murthy and J. E. Campbell.

"A Method for the Determination of Radionuclides in Milk Ash," Journal of Dairy Science, 14-1276, Aug. 1959. By G. K. Murthy, L. P. Jarnagin, and A. S. Goldin.

"A Method for the Elimination of Ashing in Strontium-90 Determination of Milk," Journal of Dairy Sciences, 43 (2) 151, Feb. 1960. By G. K. Murthy, J. E. Coakley and J. E. Campbell.

13<

TABLE IV.–PUBLIC HEALTH SERVICE DATA ON RADIOACTIVITY IN MILK

FEBRUARY 1960

Data from one sampling point supplying the cities listed below.

Radioactivity in $\mu\mu c$/liter

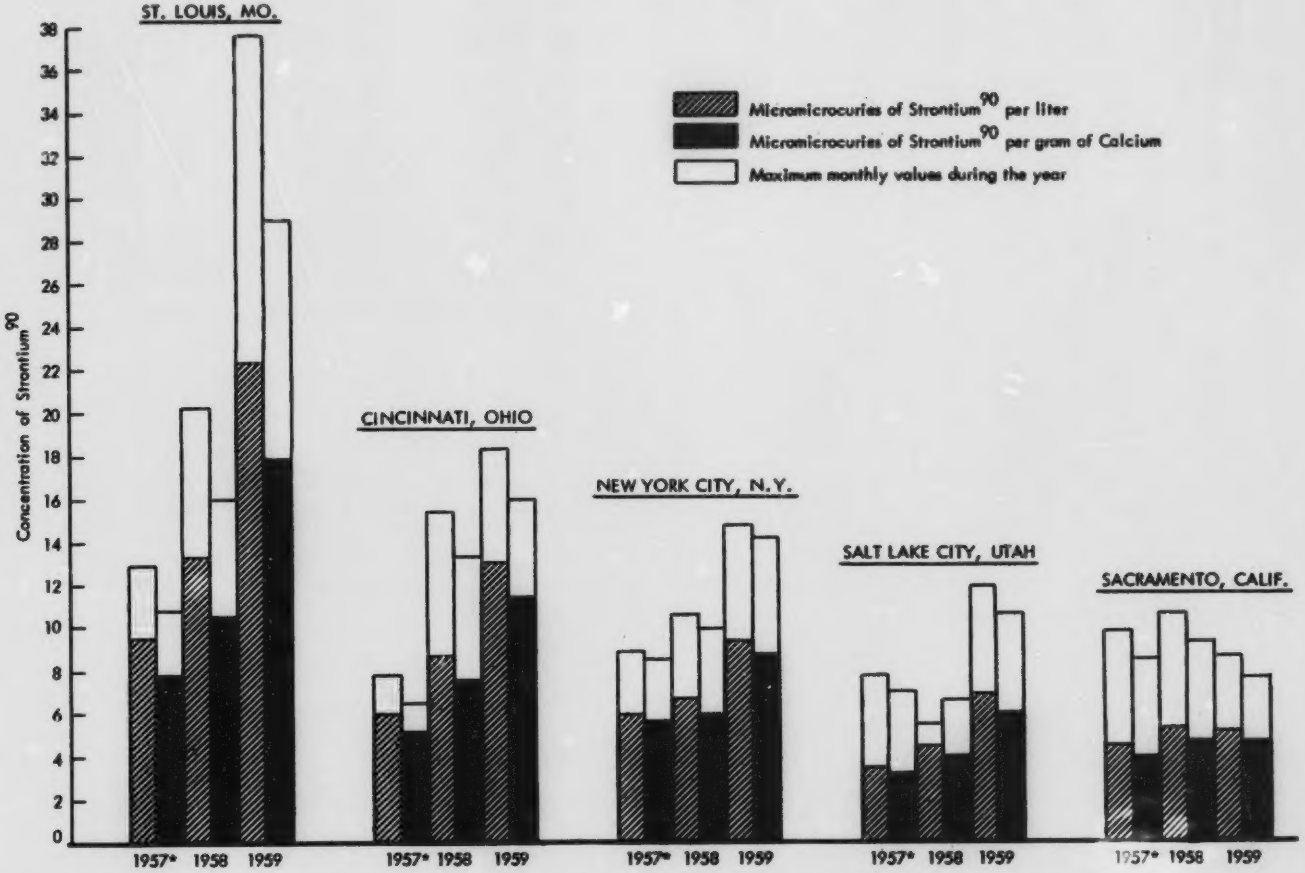
Area	Calcium grams/liter		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	Feb.	Yearly average	Feb.	Yearly average	Feb.	Yearly average	Feb.	Yearly average	Feb.	Yearly average	Feb.	Yearly average
Atlanta, Ga.	1.11	1.17	(a) 0	2	(a) 0	35	19.3	16.4	(a) 0	(a) 0	65	82
Austin, Tex.	1.12	1.12	0	1	0	18	6.8	6.2	0	0	25	43
Chicago, Ill.	1.01	1.10	0	1	0	11	8.6	9.0	0	0	45	52
Cincinnati, Ohio	1.05	1.12	0	<1	0	14	11.4	12.7	0	0	40	46
Fargo, N. Dak. Moorhead, Minn.	Final Report on this Station, January 1960.											
New York, N. Y.	1.06	1.08	0	1	0	7	9.9	9.8	0	0	45	50
Overton, Nev.	1.08	1.08	0	0	0	2	5.6	3.4	0	0	30	29
Sacramento, Calif.	1.06	1.11	0	<1	0	12	1.7	4.7	0	0	10	39
Salt Lake City, Utah	1.09	1.11	0	2	0	7	6.2	7.1	0	0	40	44
Spokane, Wash.	1.14	1.16	0	3	0	18	12.8	13.1	0	0	55	66
St. George, Utah (b)	1.12	1.11	0	<1	0	4	2.2	4.3	0	0	20	28
St. Louis, Mo.	1.37	1.26	0	<1	0	49	18.8	22.4	0	<1	35	75

(a) Zero means below detectability.
(b) Average includes 11 months from start of the regular monthly collections.

15<

FIGURE 1

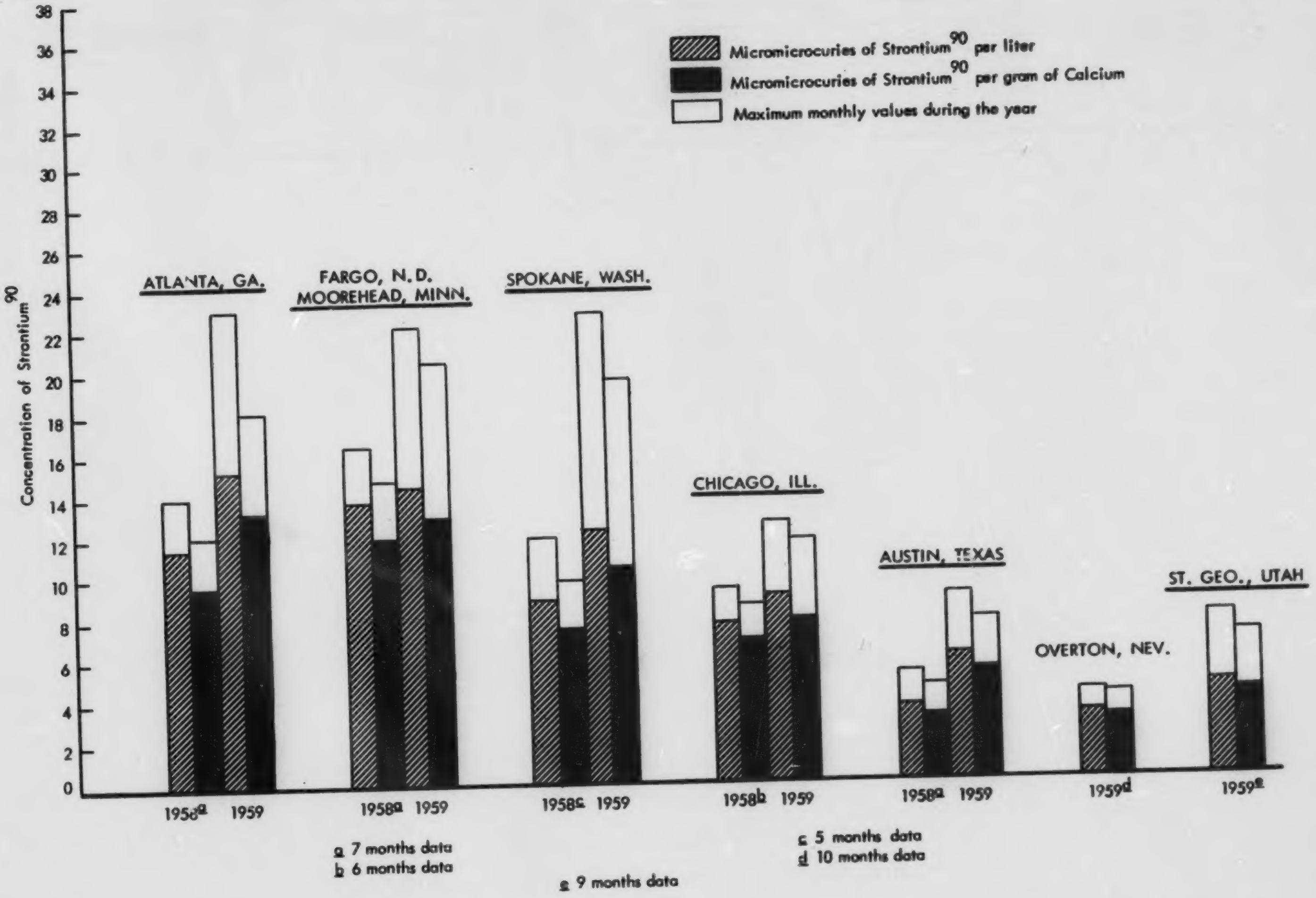
AVERAGE AND MAXIMUM ANNUAL CONCENTRATION OF STRONTIUM^{90} IN MILK
UNITED STATES, (1957 - 59)



* 8 months data

FIGURE 2

AVERAGE AND MAXIMUM ANNUAL CONCENTRATION OF STRONTIUM^{90} IN MILK (Cont.)
UNITED STATES, (1957 - 59)



16<

FIGURE 3

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK

ATLANTA, GEORGIA

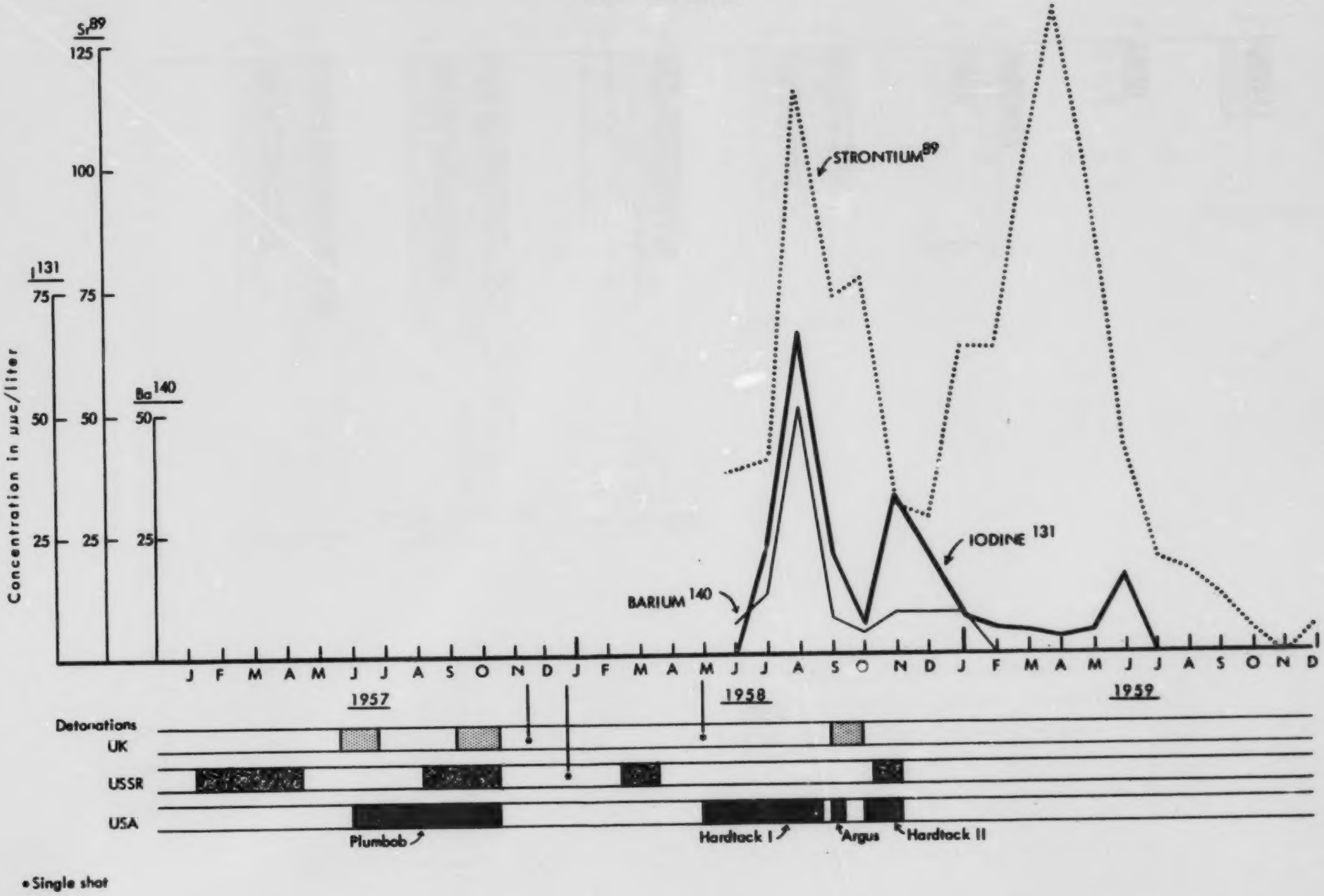
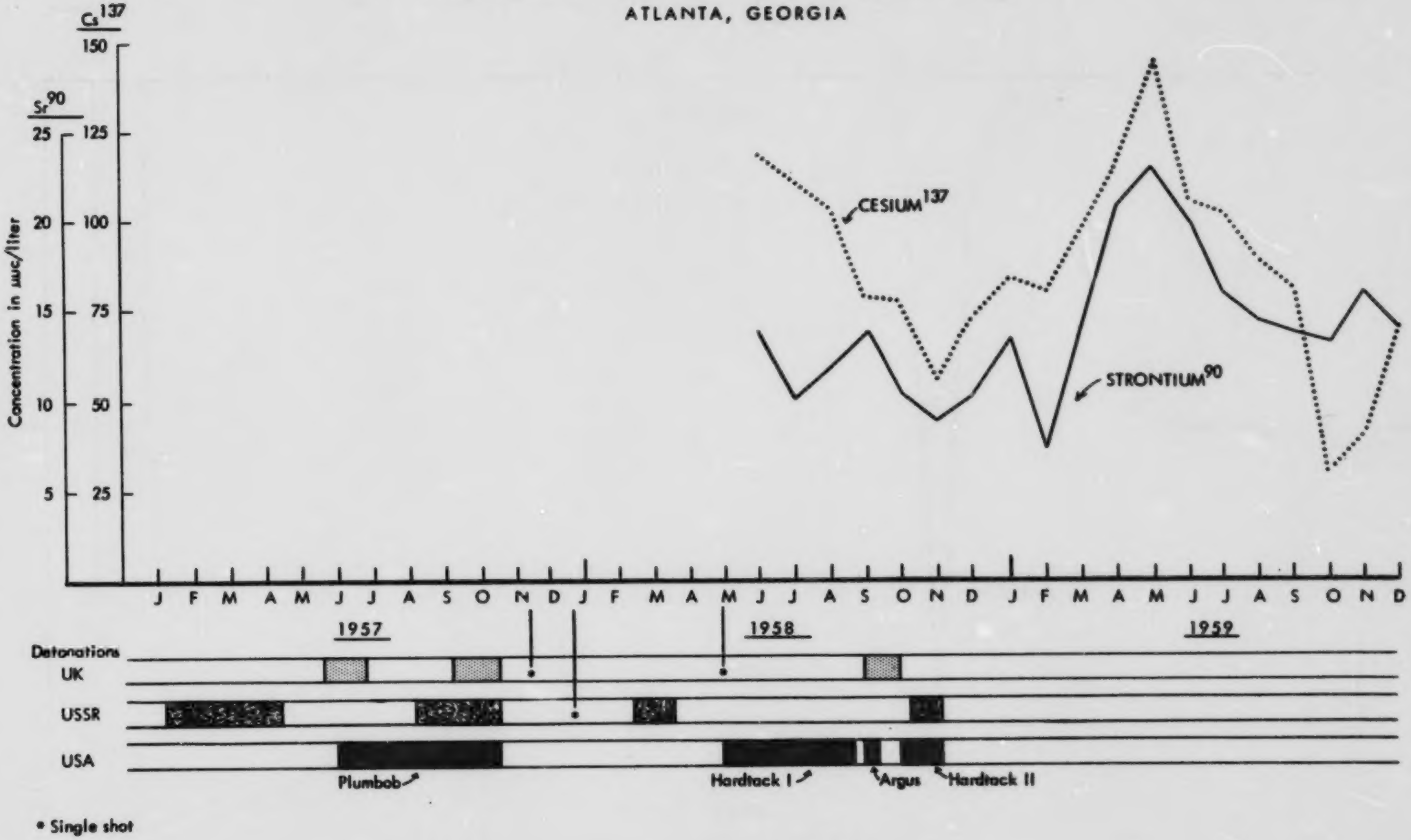


FIGURE 4

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK
ATLANTA, GEORGIA



18<

FIGURE 5

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK
AUSTIN, TEXAS

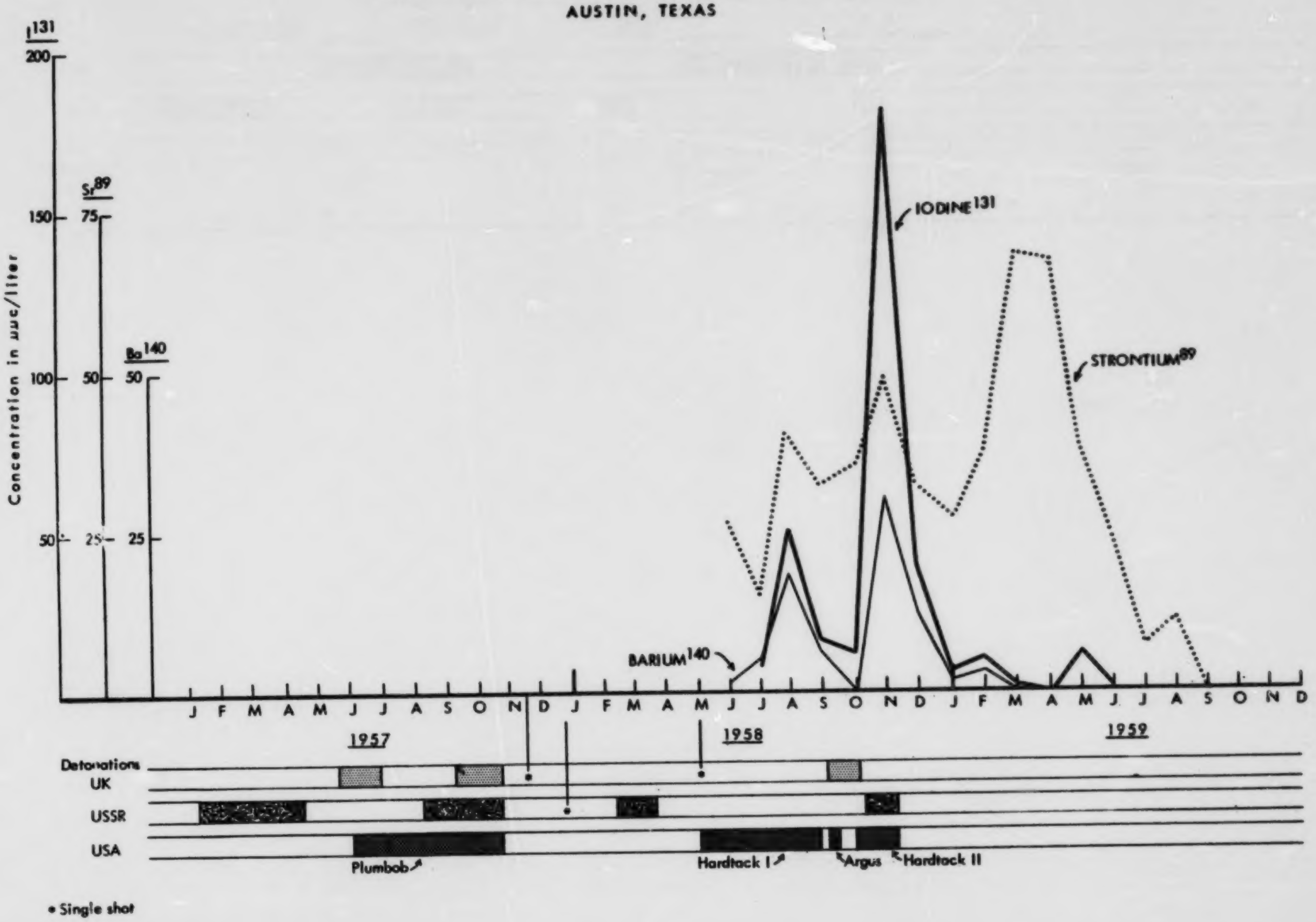


FIGURE 6

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK
AUSTIN, TEXAS

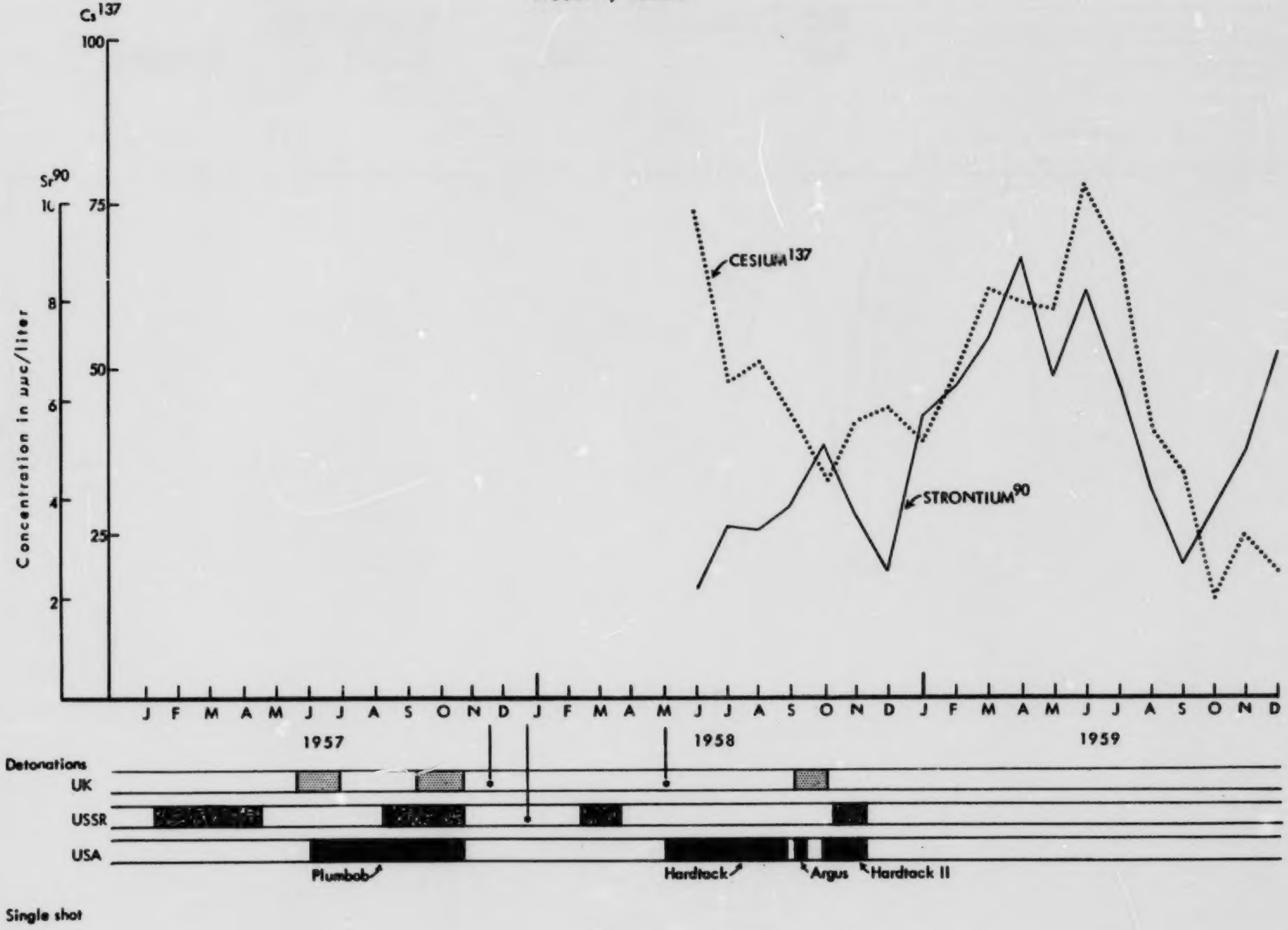


FIGURE 7

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK
CHICAGO, ILL.

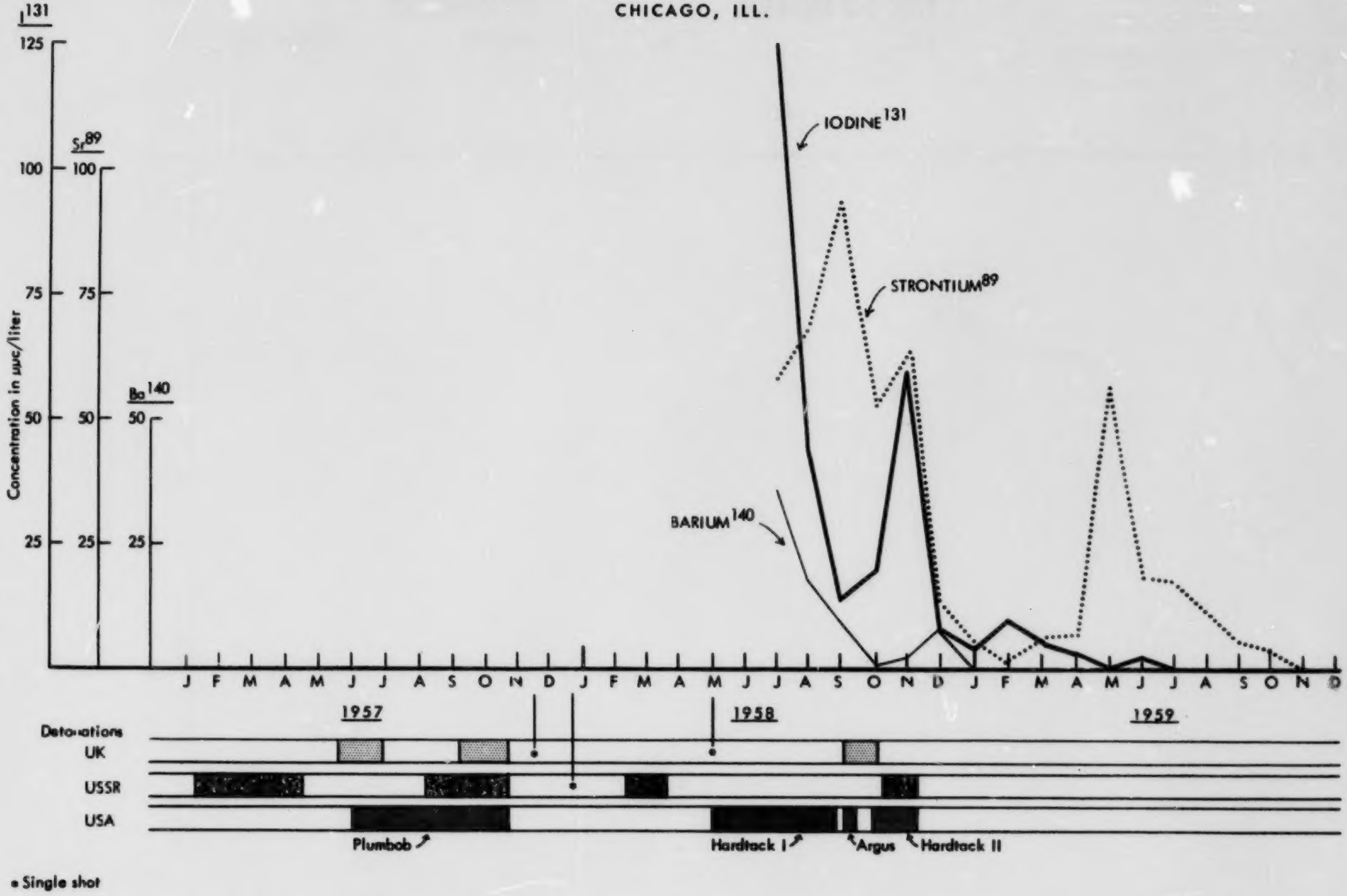


FIGURE 8

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK
CHICAGO, ILL.

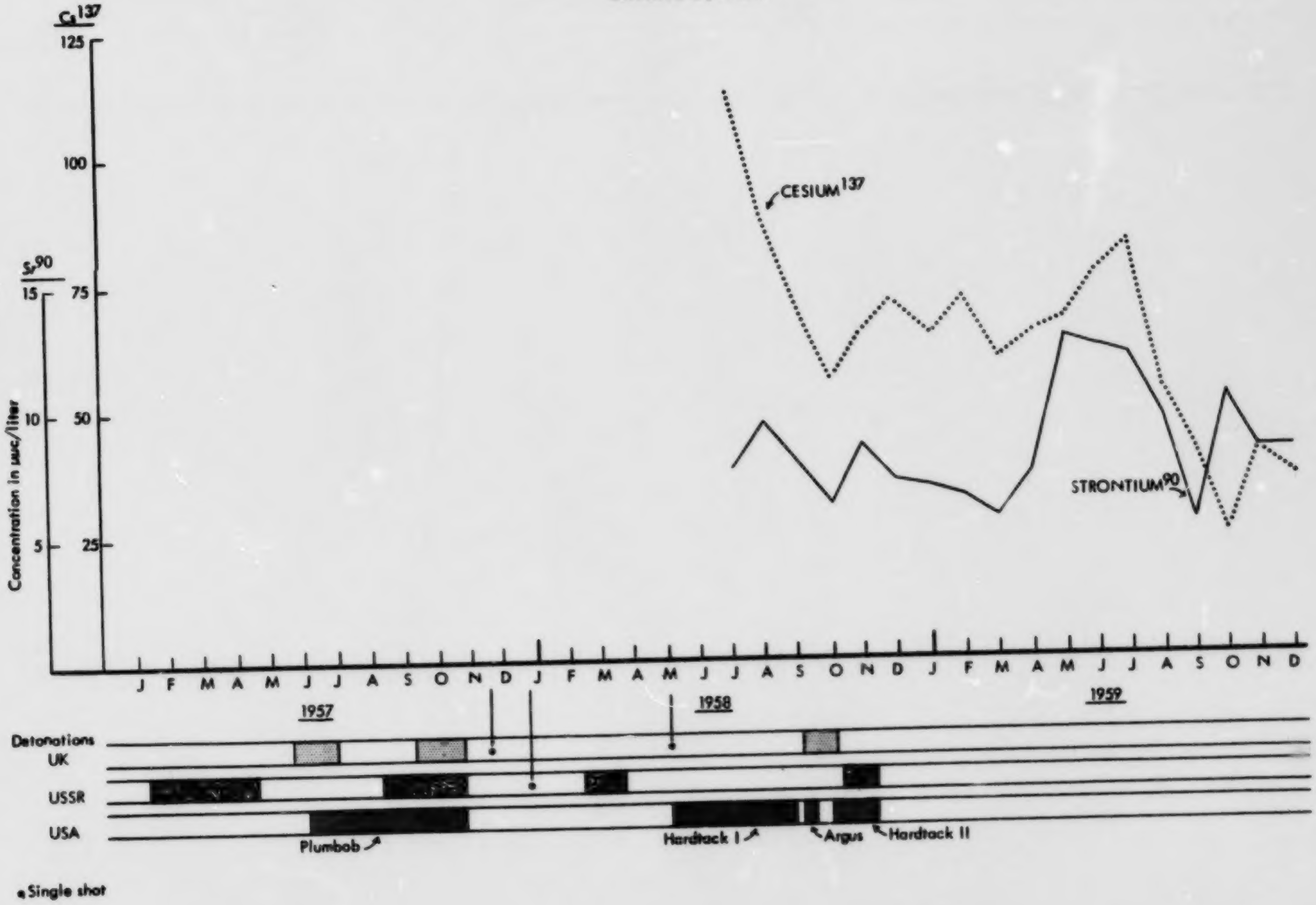


FIGURE 9

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK
CINCINNATI, OHIO

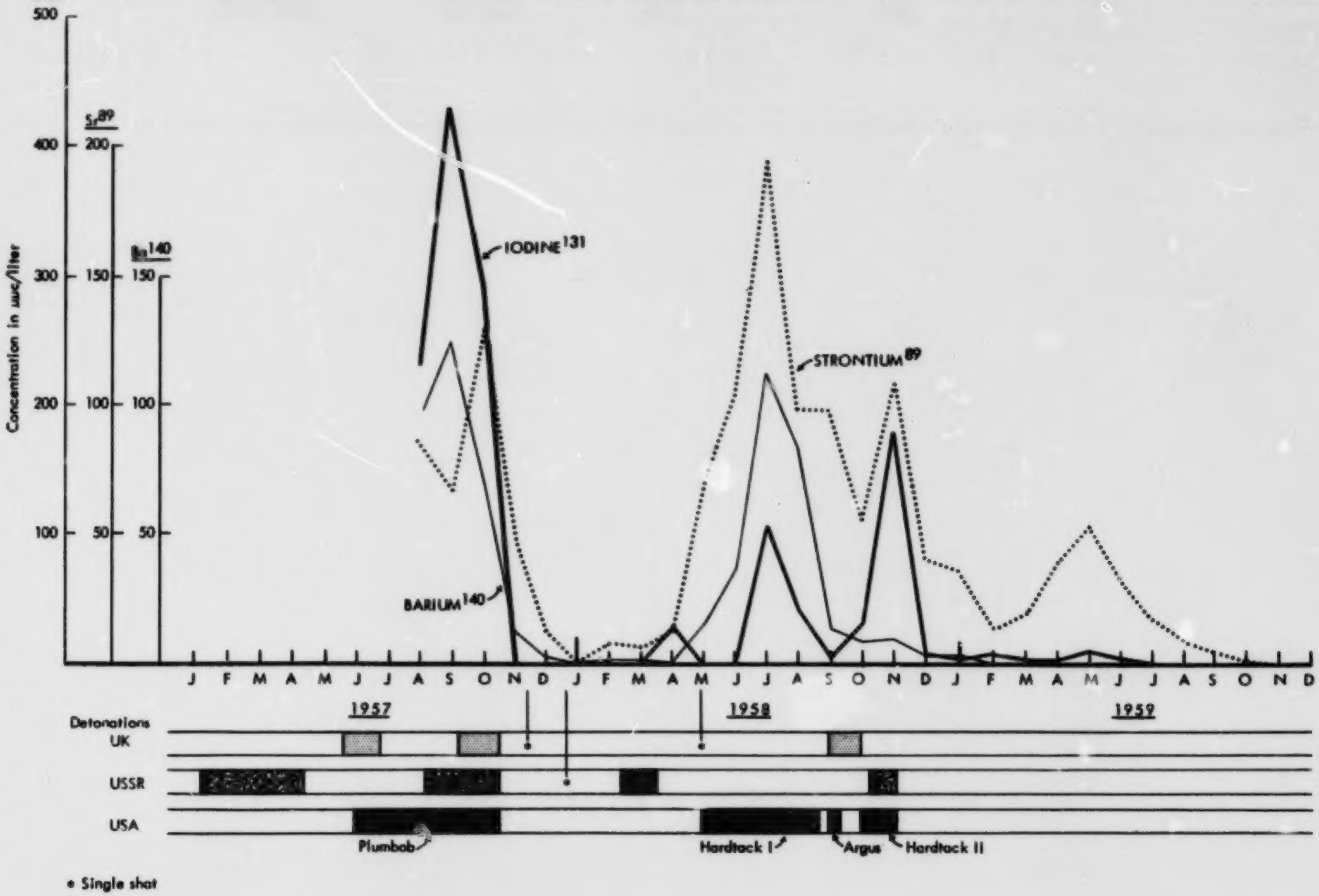


FIGURE 10

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK
CINCINNATI, OHIO

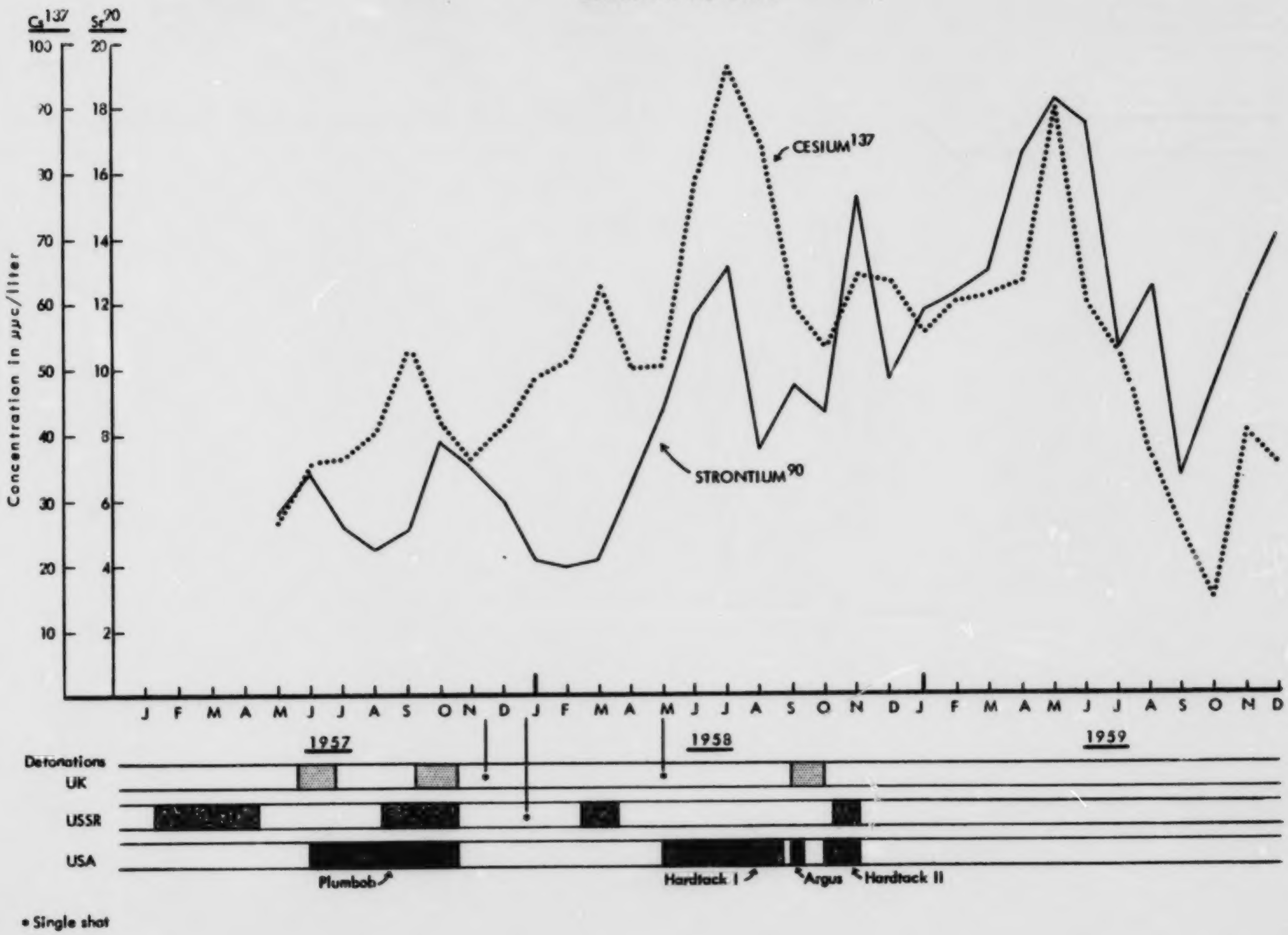


FIGURE 11

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK
FARGO, N.D. - MOOREHEAD, MINN

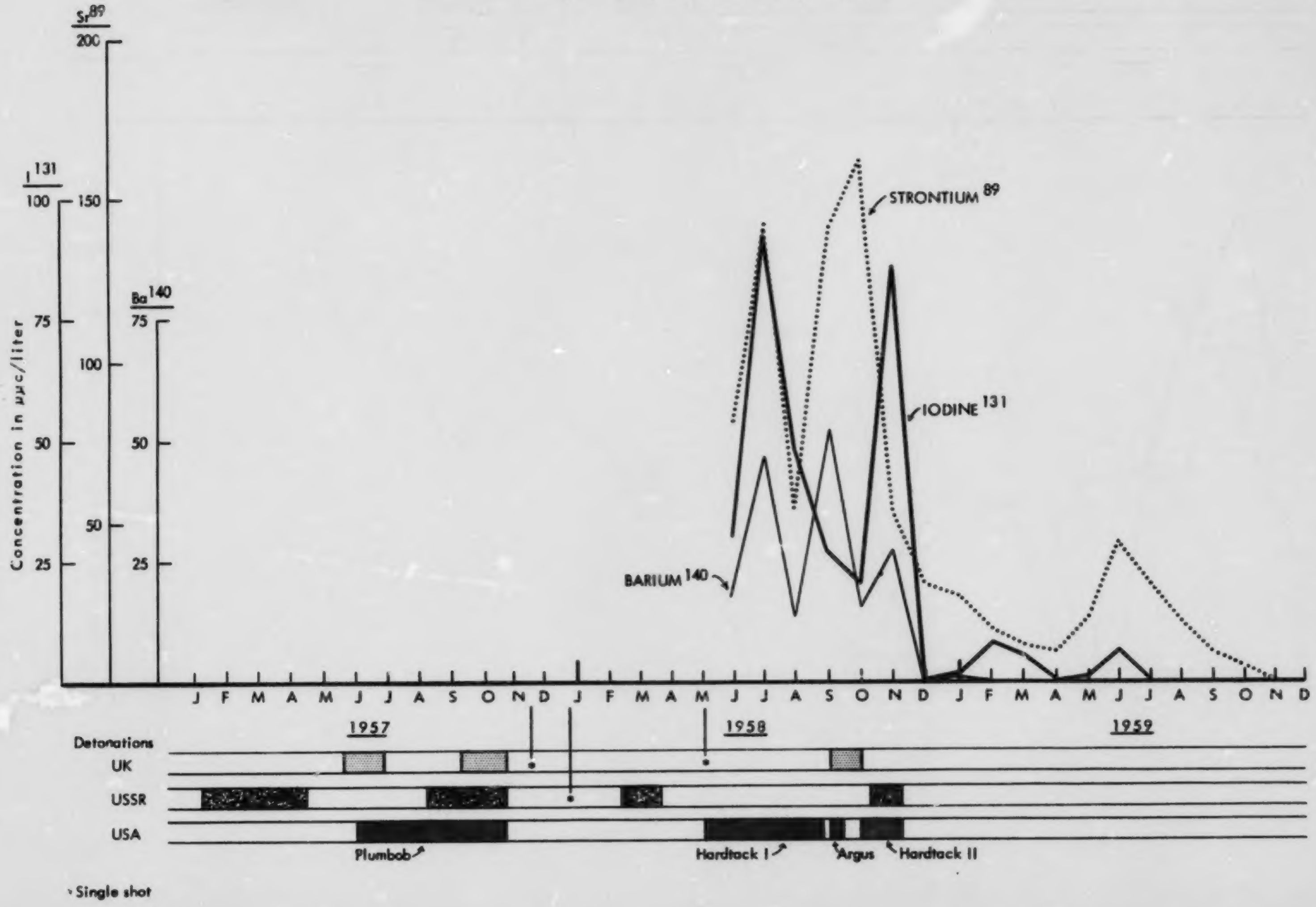


FIGURE 12

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK

FARGO, N.D. - MOOREHEAD, MINN.

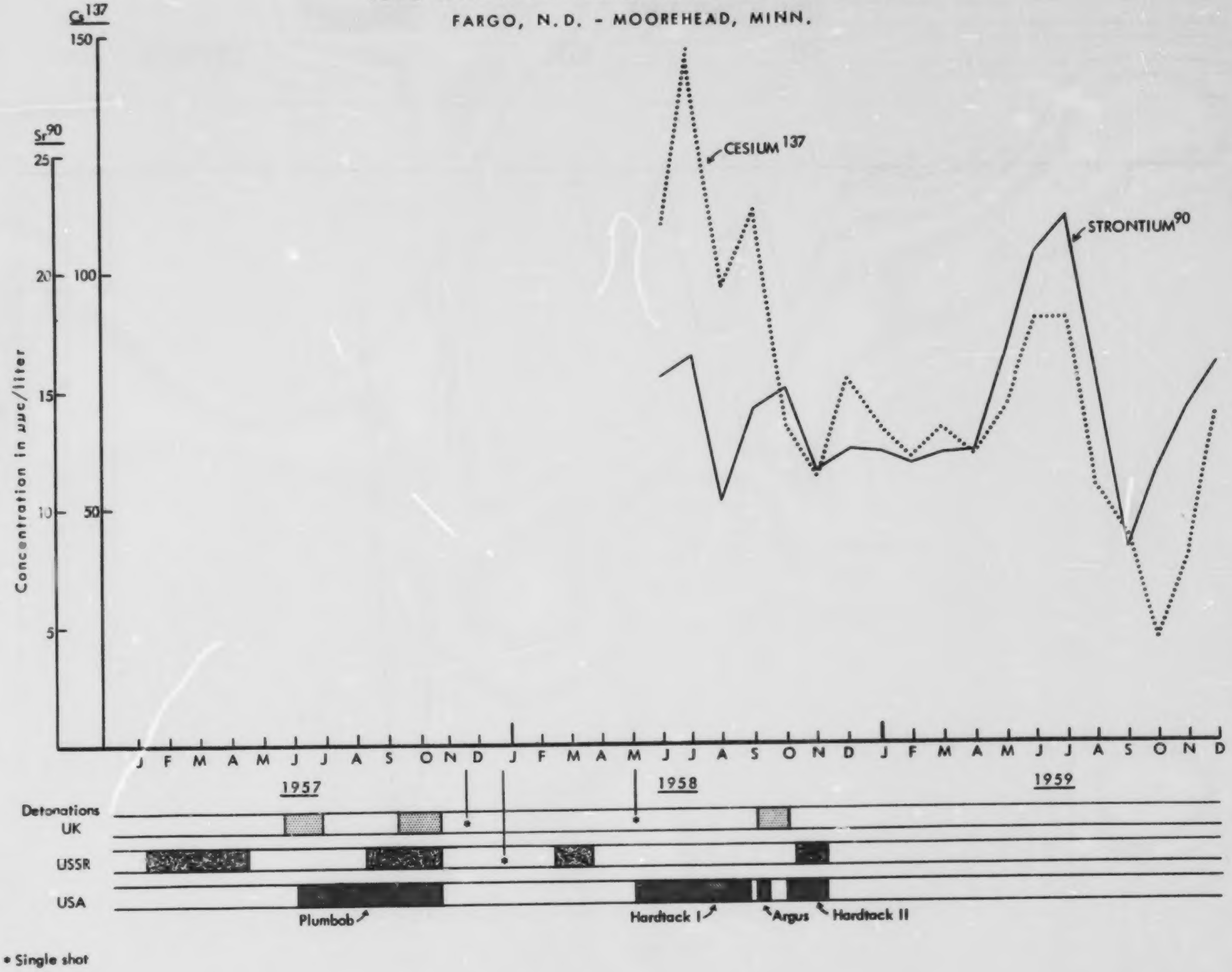


FIGURE 13

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK
NEW YORK CITY, N.Y.

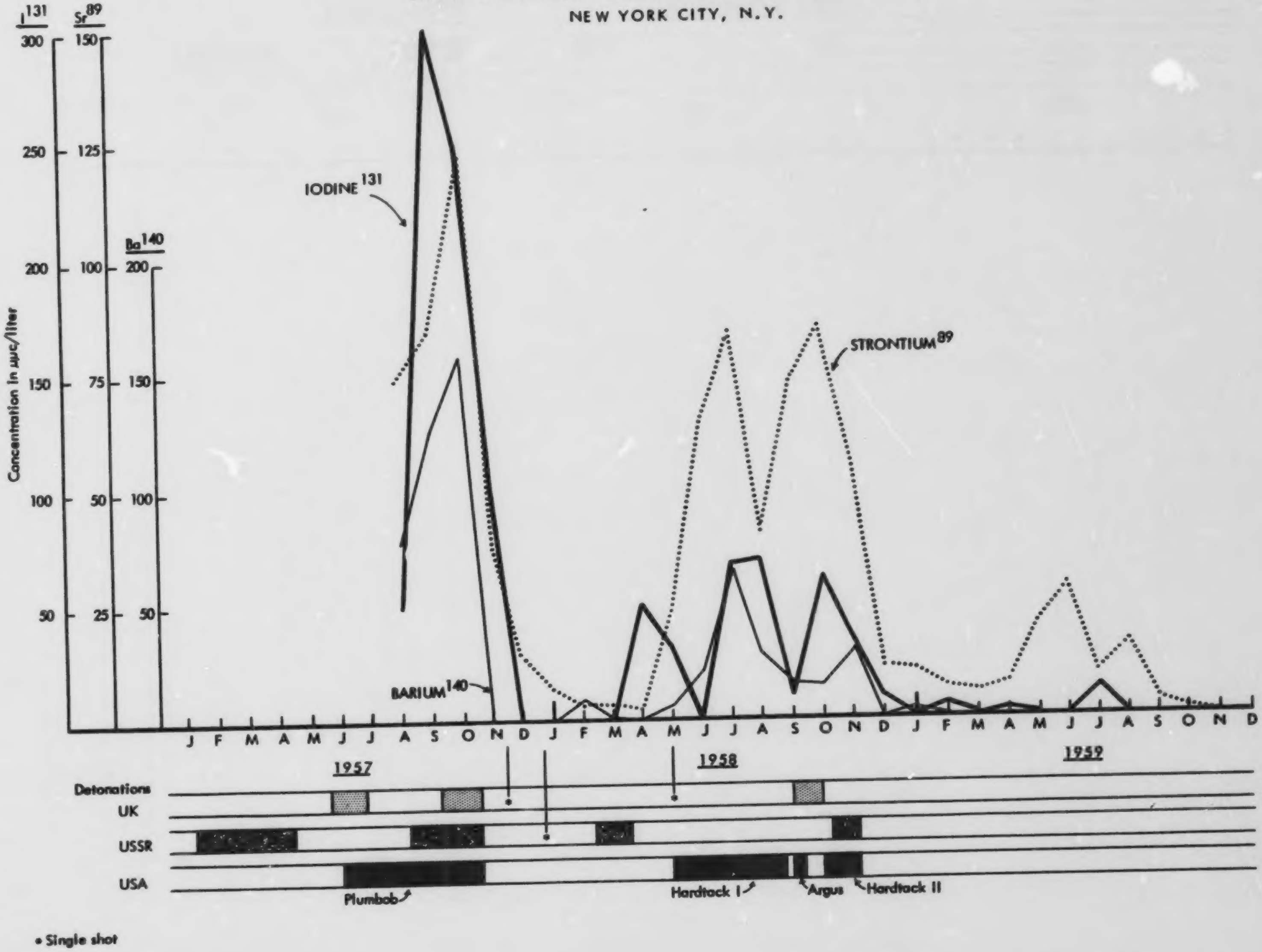


FIGURE 14

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK

NEW YORK CITY, N.Y.

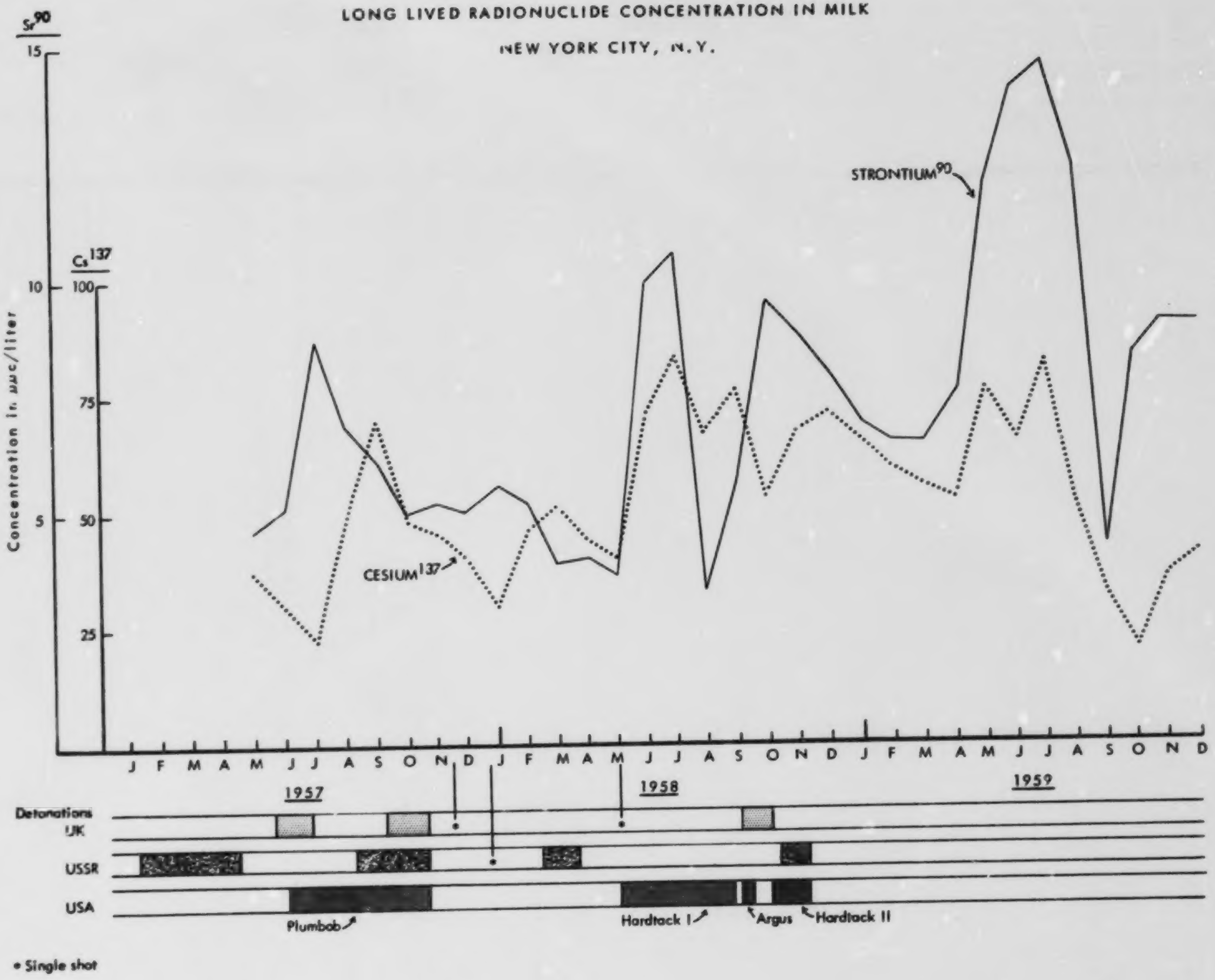


FIGURE 15

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK

SACRAMENTO, CALIF.

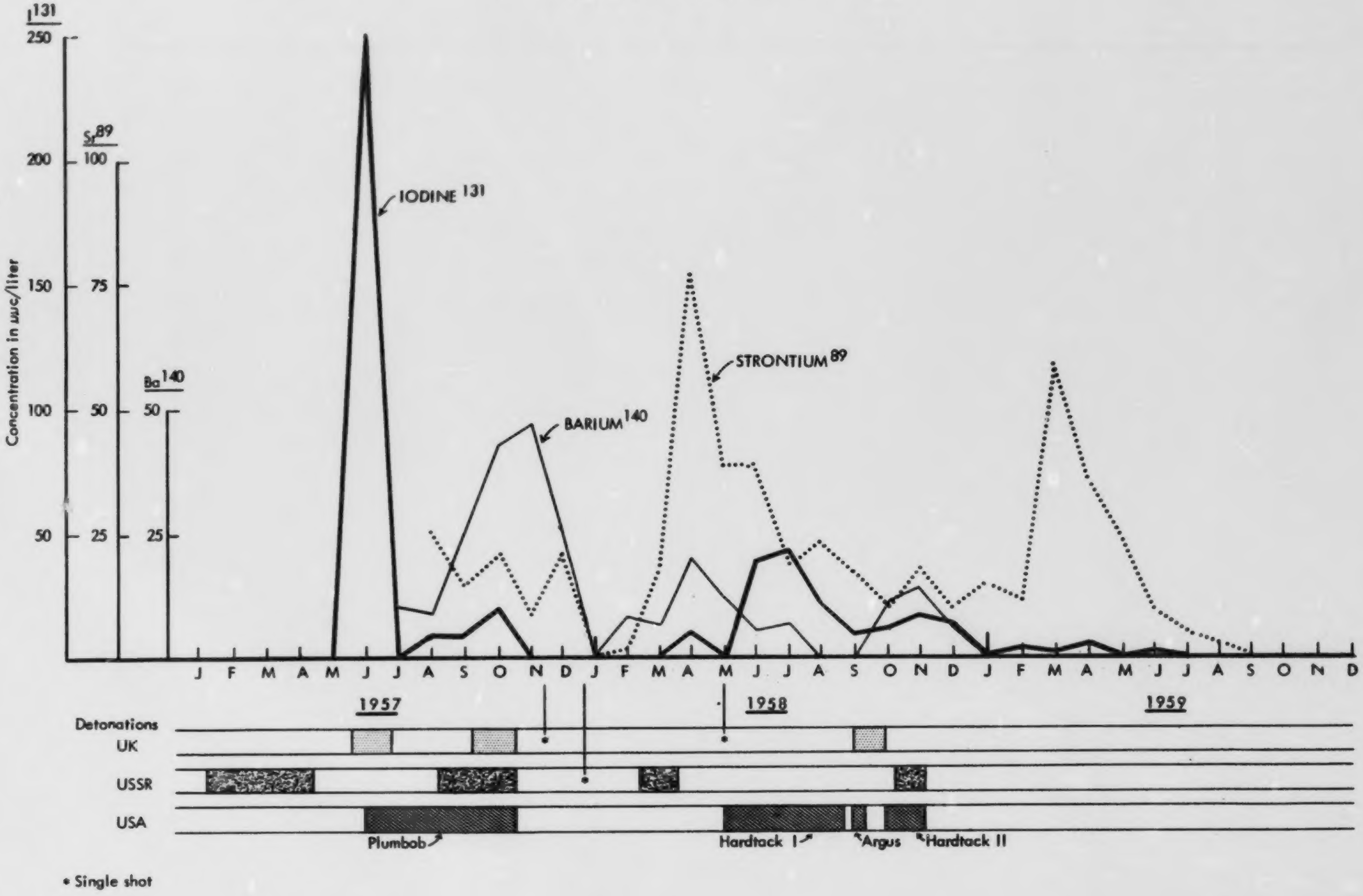


FIGURE 16

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK
SACRAMENTO, CALIF.

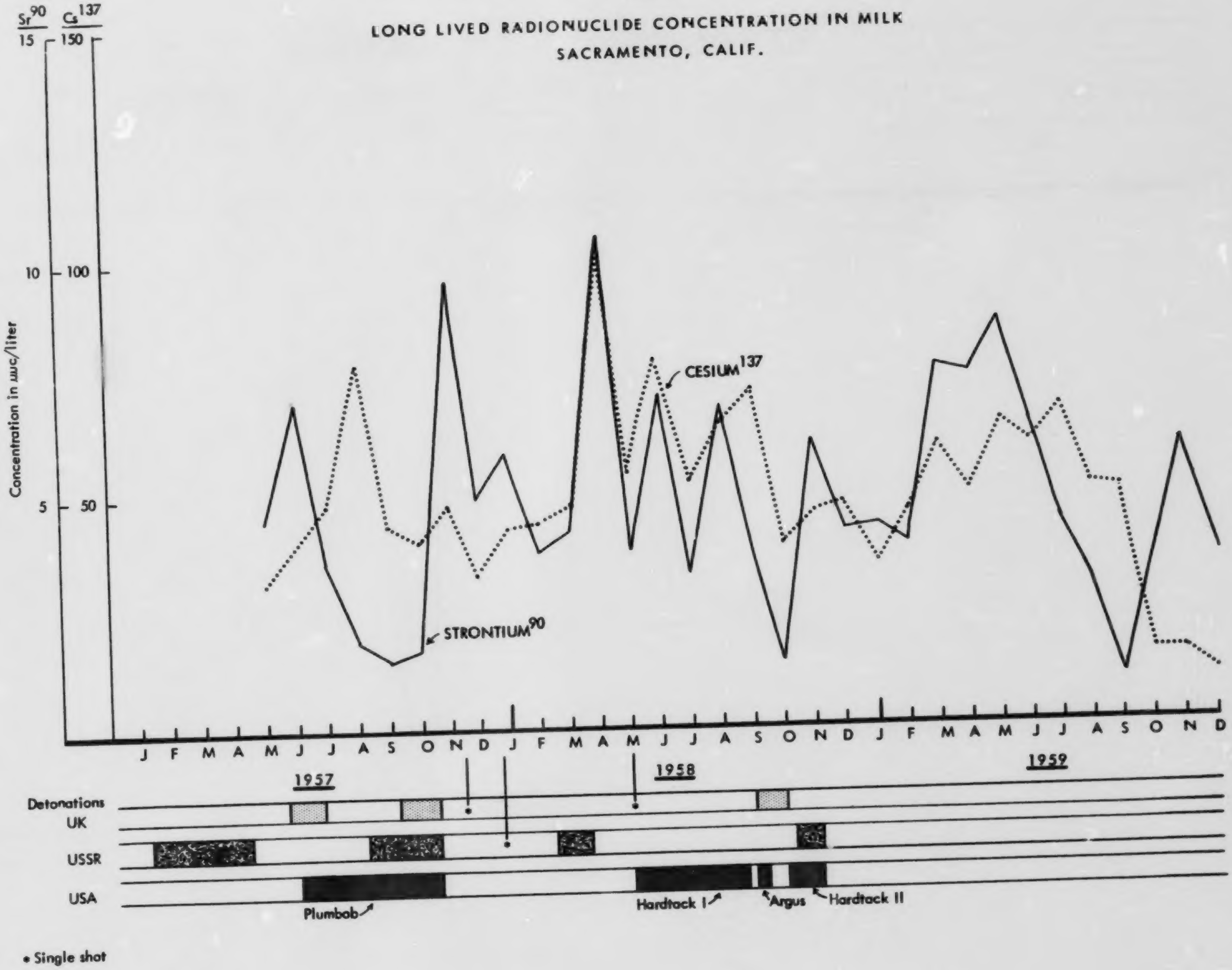
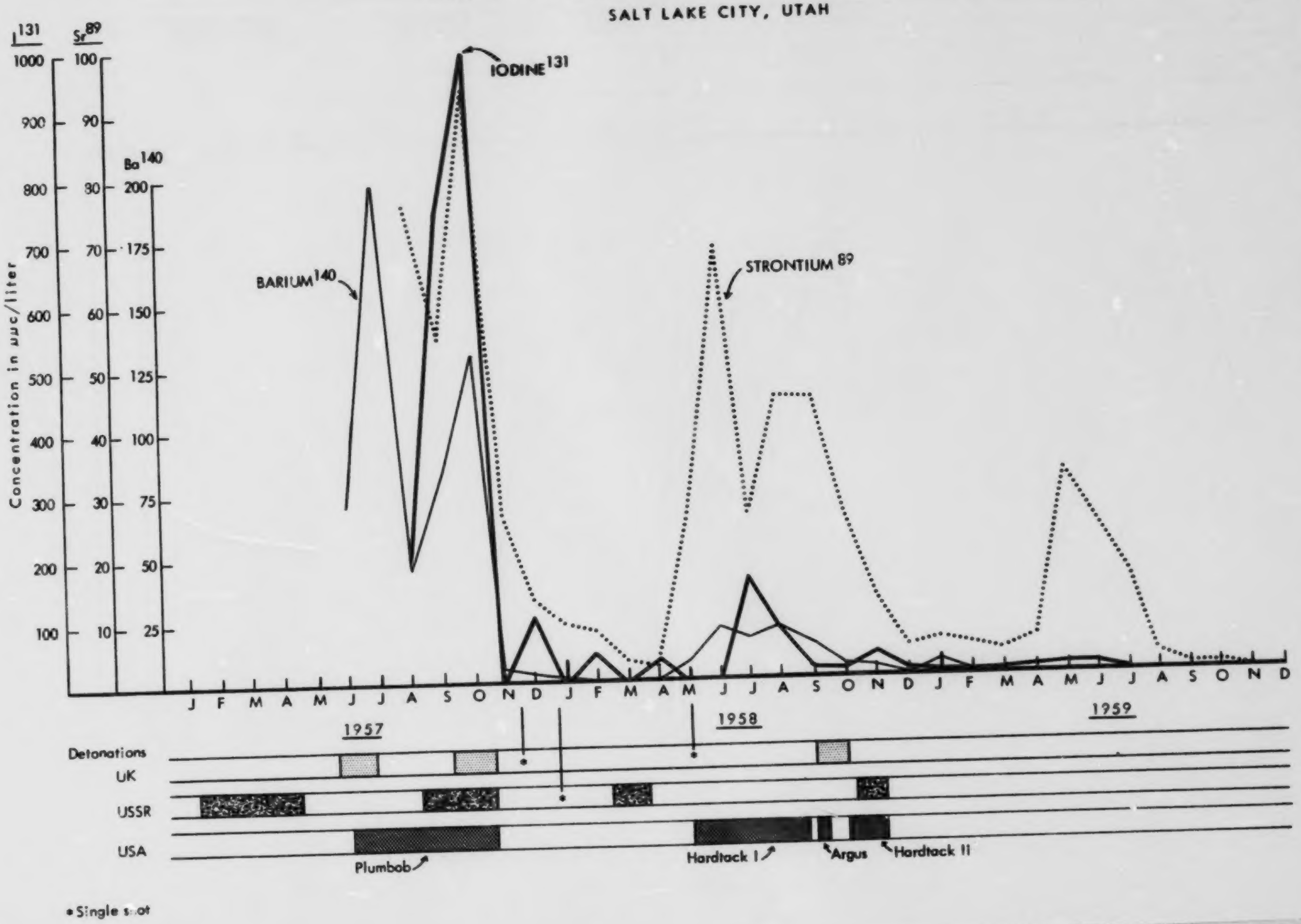


FIGURE 17

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK
SALT LAKE CITY, UTAH



31<

FIGURE 18

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK
SALT LAKE CITY, UTAH

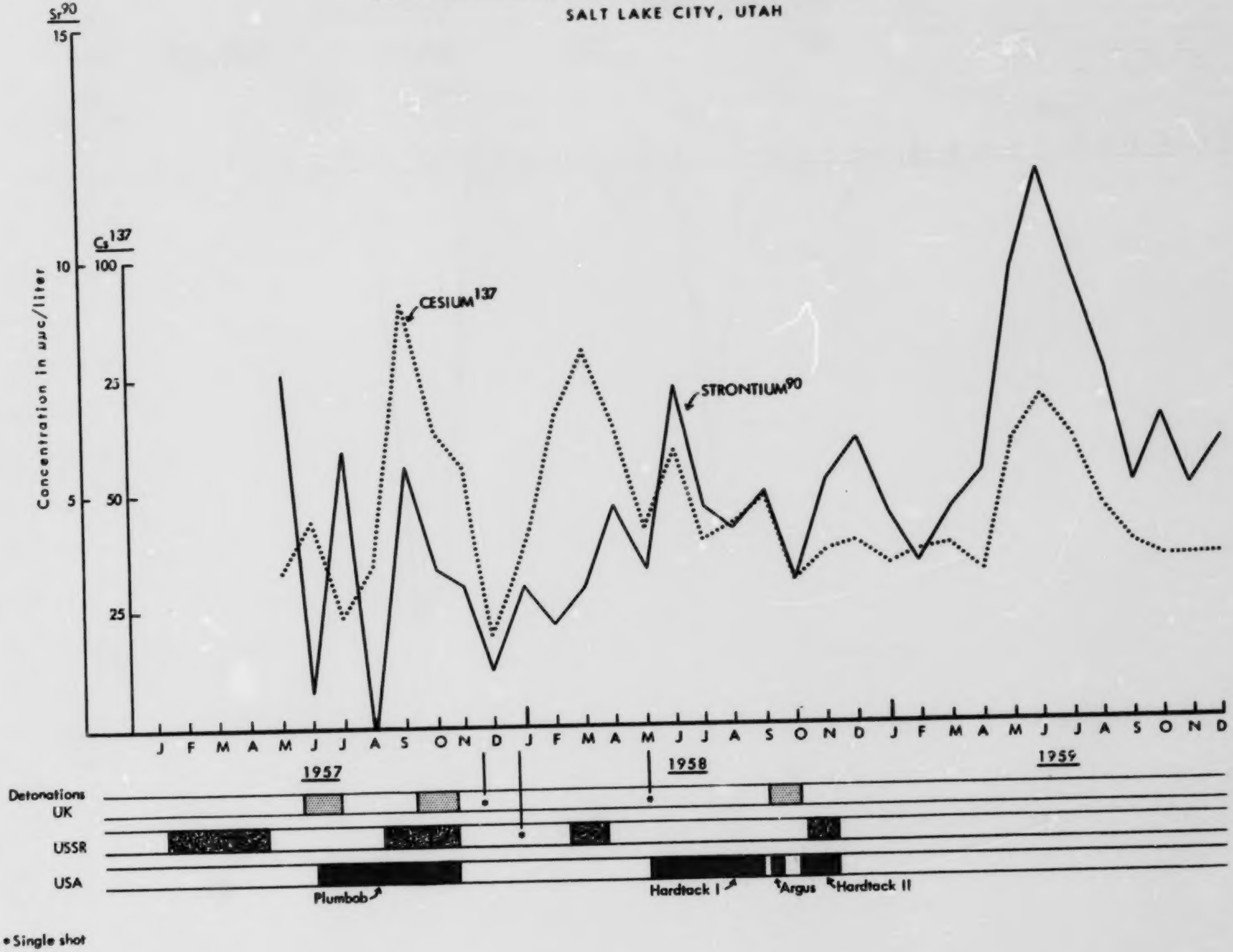


FIGURE 19

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK

ST LOUIS, MISSOURI

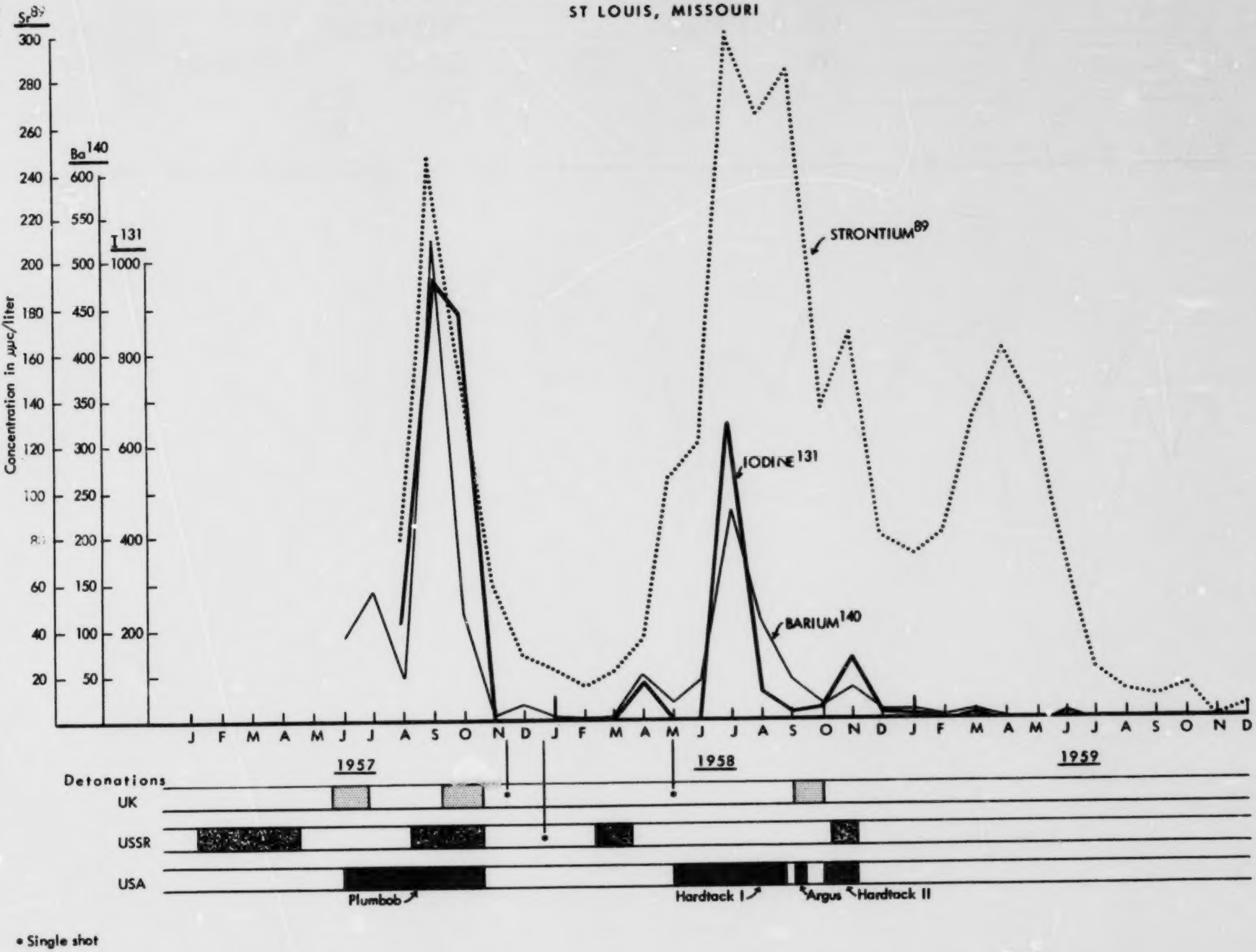
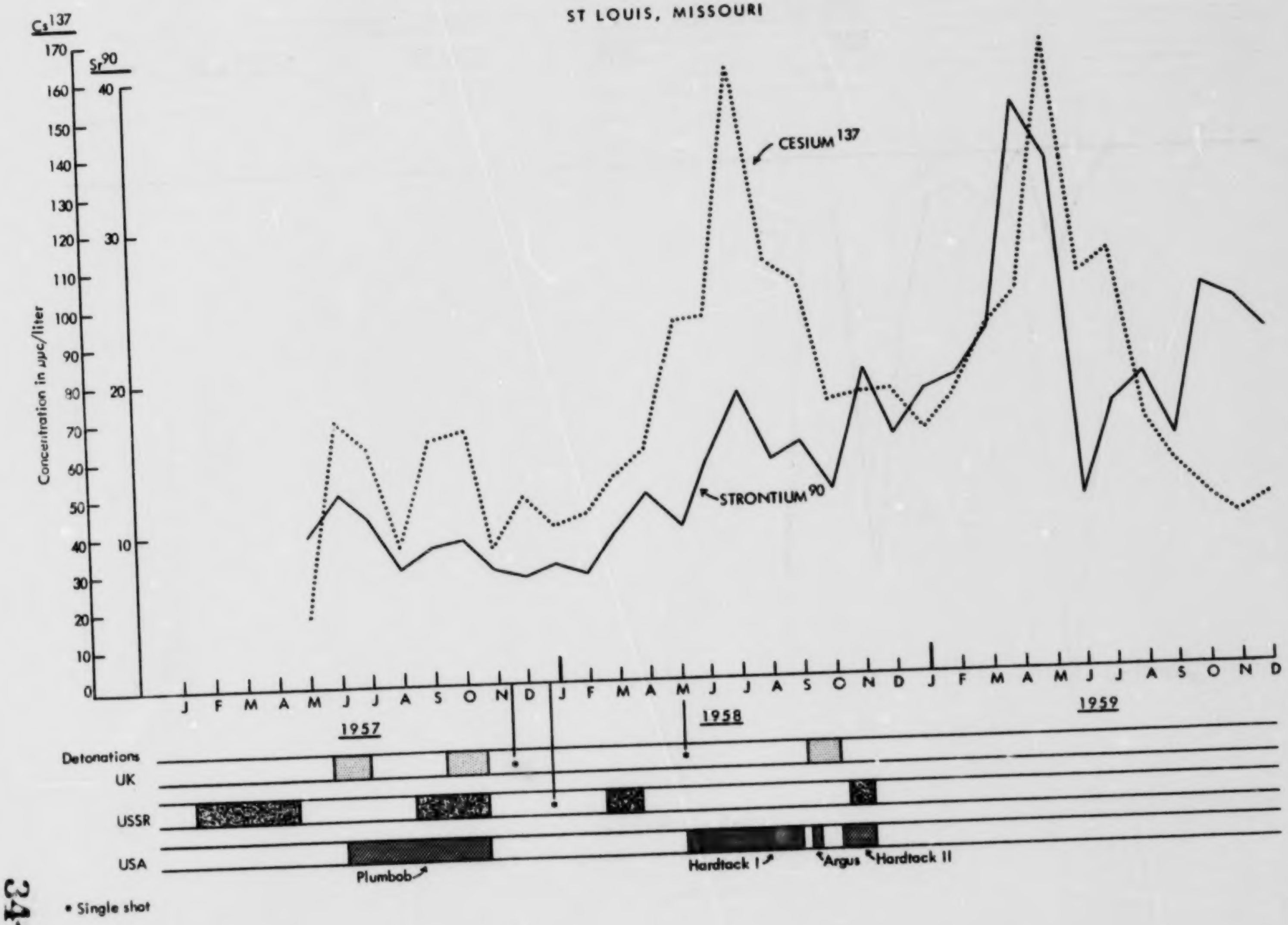


FIGURE 20

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK

ST LOUIS, MISSOURI



34<

FIGURE 21

SHORT LIVED RADIONUCLIDE CONCENTRATION IN MILK
SPOKANE, WASH.

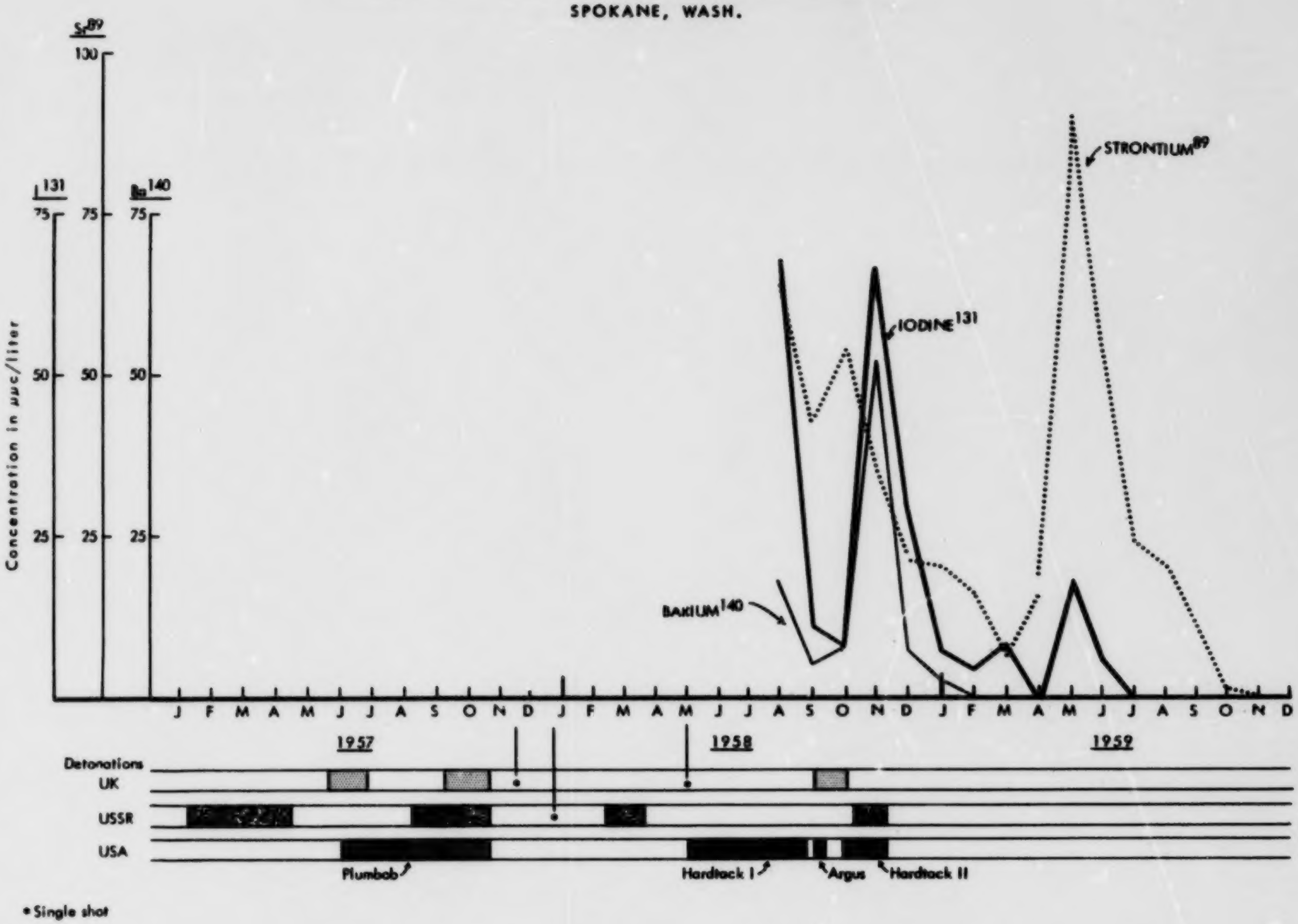
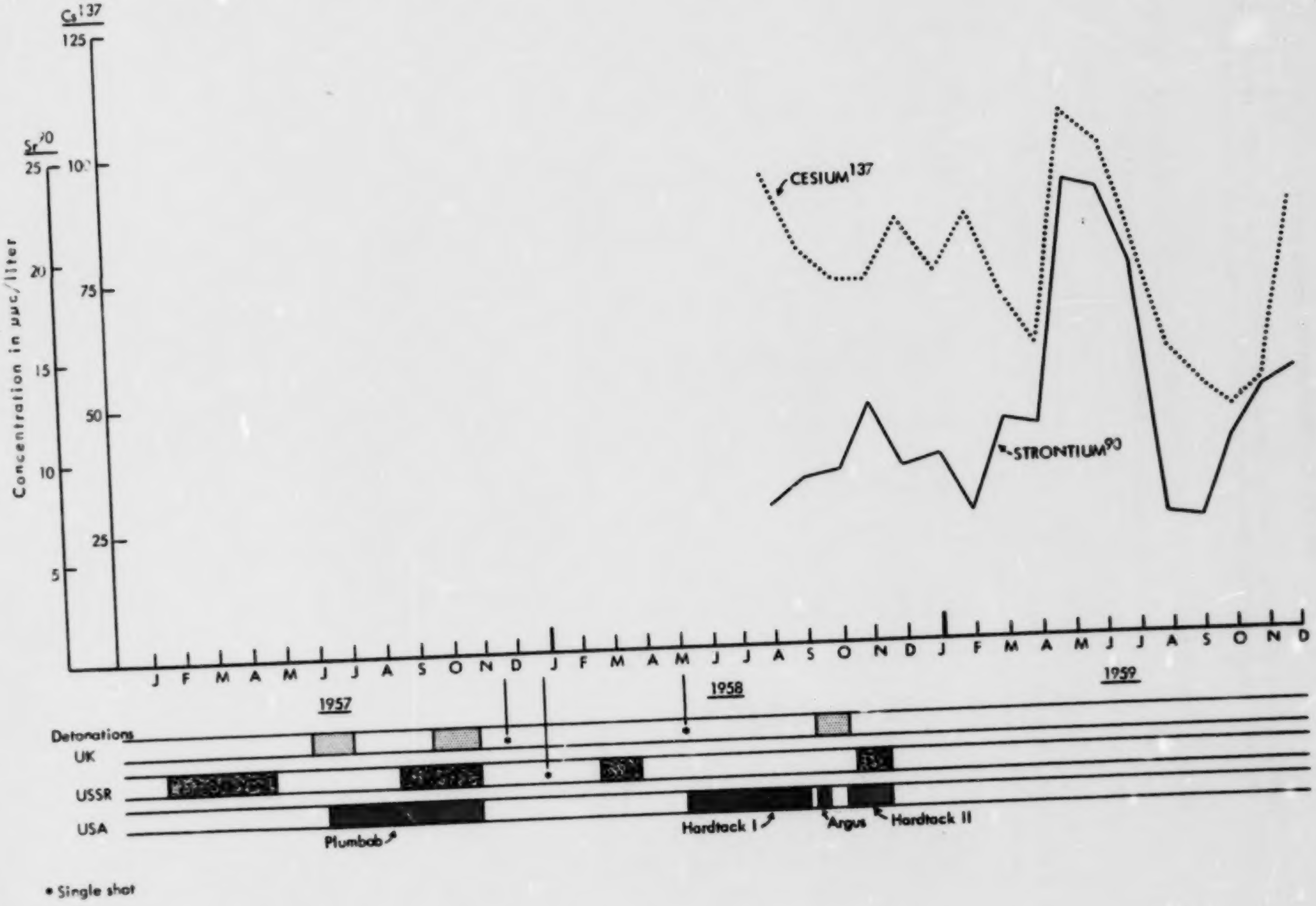


FIGURE 22

LONG LIVED RADIONUCLIDE CONCENTRATION IN MILK

SPOKANE, WASH.



STATE OF MINNESOTA MILK DATA

The Minnesota Department of Health, Division of Environmental Sanitation has reported the analyses of milk from September 1958 to December 1959. These results are contained in Table V.

TABLE V.--STRONTIUM-90 IN MILK COLLECTED AT SEVEN LOCATIONS IN MINNESOTA
(Micromicrocuries of Strontium-90 Per Liter of Milk)

Date collected	Location						
	Brainerd	Duluth	Fairbault	Minneapolis	Rochester	Thief River Falls	Worthington
5/58	23.0	24.0				9.7	
10/58		21.0	10.4	6.8			
11/58	19.5	21.0	10.7	12.5		14.0	
12/58	16.0	22.0	8.1	8.5		12.0	
1/59	19.6	16.4	13.6	14.0		15.9	
2/59	17.8	18.6	6.4	9.7		14.4	
3/59	16.4	21.6	12.6	9.9			7.0
4/59		20.3		10.4		12.6	7.2
5/59	17.8	30.7		16.9			12.8
6/59	32.4	25.9		16.8		16.3	12.1
7/59	23.3	16.0		10.4			9.9
8/59	18.1	15.8		7.7		9.7	6.2
9/59	16.4	15.3		8.2	8.7	9.3	5.4
10/59		17.0		10.0	10.7		5.6
11/59	27.5	15.2		10.2	6.3	12.1	
12/59	18.9	17.6			8.2		

*Samples are daily two ounce samples composited over a one month period.

37<

SECTION III

AIR

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in environmental radiation due to radioactive fallout during nuclear weapons tests. The program has proven sufficiently valuable that it has been extended to a round-the-year basis and currently consists of 44 stations at urban locations (see figure 1) operated by State and local health department personnel with 3 operated by U. S. Public Health Service personnel.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment, and thus act as an "alert" system. These data alone are not conducive to evaluation directly of biological hazards. However, field measurements do enable the operator to estimate the amount of beta activity of particulates in the air at the station five hours after collection, by comparison to a known source, using a portable survey meter. The filters are then forwarded to the laboratory in Washington for a more refined measurement using a thin window proportional counter.

Air samplers are in operation at the 44 stations on an average of 70% of the week. Air is drawn through a cellulose carbon loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small dust-like particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

About 85% of the stations collect samples of precipitation which are sent to Washington for analysis. Values are now below limits of detection by present instrumentation. New equipment is being procured to measure lower values. Measurements have indicated that the bulk of deposited activity occurs through precipitation but concentrations in surface air are not directly relatable to the amount deposited through precipitation.

Table VI presents a summary of the latest monthly data.

Monthly averages of beta activity in air are shown for each station graphically in figures 24 through 67.

39<

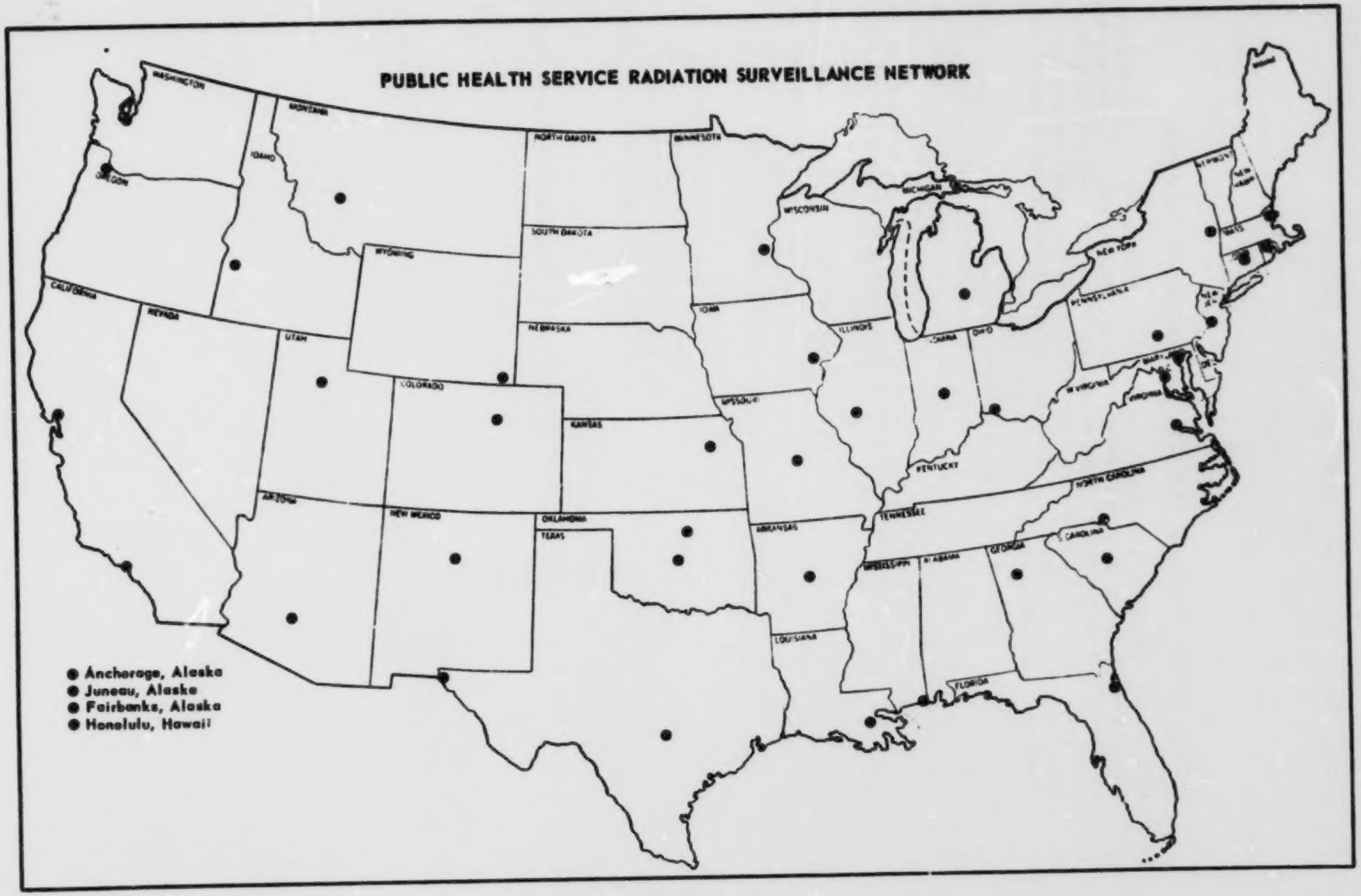

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK
● Anchorage, Alaska
● Juneau, Alaska
● Fairbanks, Alaska
● Honolulu, Hawaii
WASHINGTON
OREGON
CALIFORNIA
IDAHO
MONTANA
NEVADA
UTAH
WYOMING
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
VIRGINIA
W. VIRGINIA
PENNSYLVANIA
NEW YORK
VERMONT
NEW HAMP.
MASS.
MAINE

FIGURE 23

TABLE VI.—PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Radioactivity of Particulates in Air
Micromicrocuries Per Cubic Meter—Gross Beta Counts
For month of February 1960

Station location	Weighted averages	Maximum	Minimum
Alaska, Anchorage	< 0.11	0.27	< 0.10
Alaska, Fairbanks	< 0.12	0.21	< 0.10
Alaska, Juneau	< 0.12	0.27	< 0.10
Arizona, Phoenix	0.29	0.66	0.20
Arkansas, Little Rock	< 0.12	0.17	< 0.10
California, Berkeley	< 0.17	0.38	< 0.10
California, Los Angeles	< 0.21	0.35	< 0.10
Colorado, Denver	< 0.29	1.38	< 0.10
Connecticut, Hartford	< 0.13	0.51	< 0.10
District of Columbia	< 0.16	0.44	< 0.10
Florida, Jacksonville	< 0.17	0.53	< 0.10
Georgia, Atlanta	< 0.20	0.51	< 0.10
Hawaii, Honolulu	< 0.16	0.33	< 0.10
Idaho, Boise	-	-	-
Illinois, Springfield	< 0.17	0.75	< 0.10
Indiana, Indianapolis	< 0.13	0.23	< 0.10
Iowa, Iowa City	< 0.14	0.23	< 0.10
Kansas, Topeka	< 0.12	0.18	< 0.10
Louisiana, New Orleans	< 0.19	0.31	< 0.10
Maryland, Baltimore	< 0.15	0.31	< 0.10
Massachusetts, Lawrence	< 0.10	0.13	< 0.10
Michigan, Lansing	< 0.12	0.17	< 0.10
Minnesota, Minneapolis	< 0.12	0.18	< 0.10
Mississippi, Pascagoula	< 0.23	0.64	< 0.10
Missouri, Jefferson City	< 0.13	0.17	< 0.10
Montana, Helena	< 0.16	0.28	< 0.10
New Jersey, Trenton	< 0.12	0.18	< 0.10
New Mexico, Santa Fe	< 0.27	0.79	< 0.10
New York, Albany	< 0.11	0.17	< 0.10
North Carolina, Gastonia	< 0.20	0.47	< 0.10
Ohio, Cincinnati	0.30	0.70	0.09
Oklahoma, Oklahoma City	< 0.15	0.28	< 0.10
Oklahoma, Ponca City	< 0.10	0.19	< 0.10
Oregon, Portland	< 0.17	0.35	< 0.10
Pennsylvania, Harrisburg	< 0.16	0.30	< 0.10
Rhode Island, Providence	< 0.14	0.31	< 0.10
South Carolina, Columbia	< 0.16	0.36	< 0.10
South Dakota, Pierre	< 0.15	0.23	< 0.10
Texas, Austin	< 0.16	1.08	< 0.10
Texas, El Paso	0.38	1.45	0.11
Utah, Salt Lake City	< 0.23	1.70	< 0.10
Virginia, Richmond	< 0.13	0.26	< 0.10
Washington, Seattle	< 0.14	0.36	< 0.10
Wyoming, Cheyenne	< 0.15	0.25	< 0.10

40<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Anchorage, Alaska
Radiation Surveillance Network

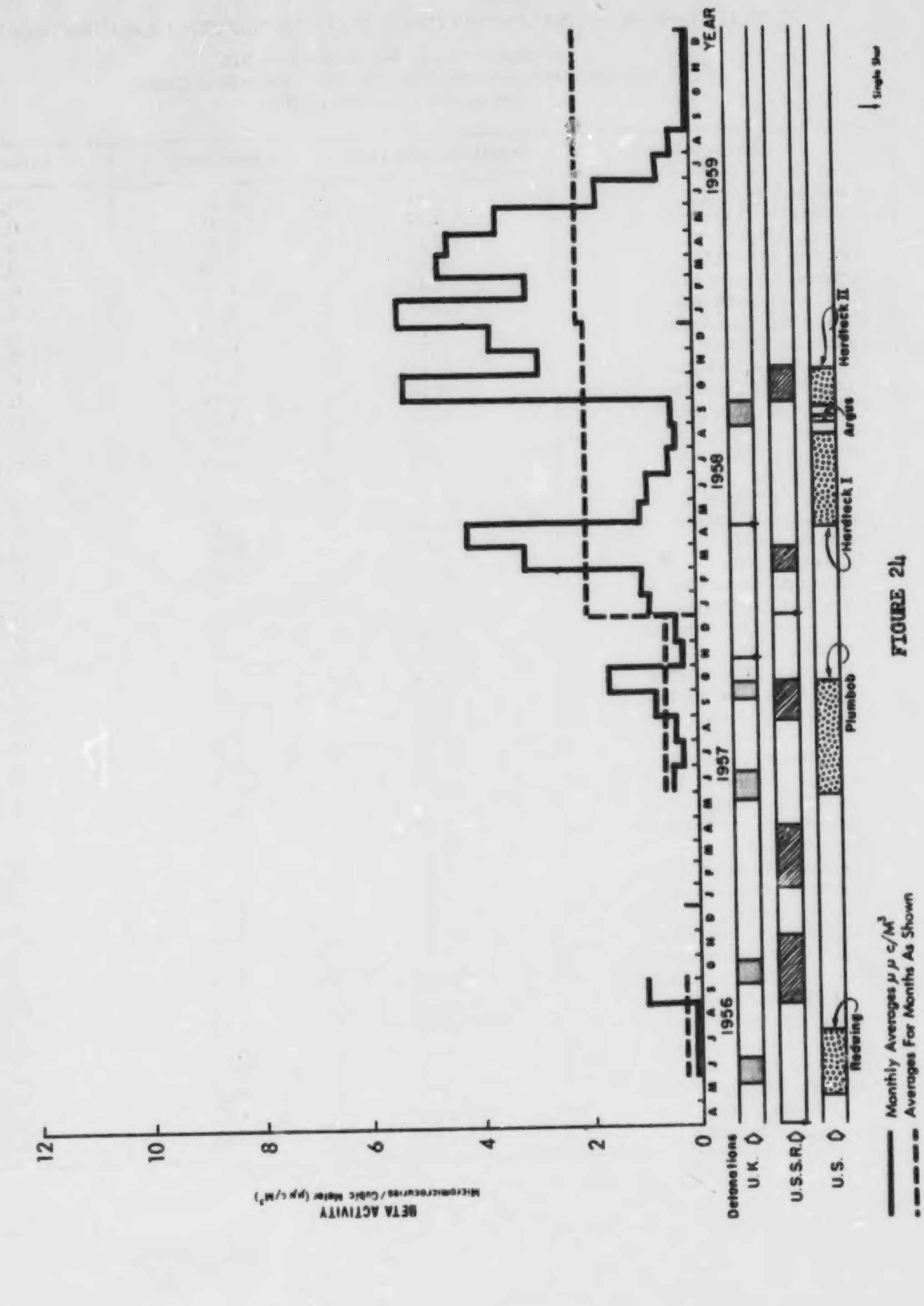


FIGURE 24

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Fairbanks, Alaska
Radiation Surveillance Network

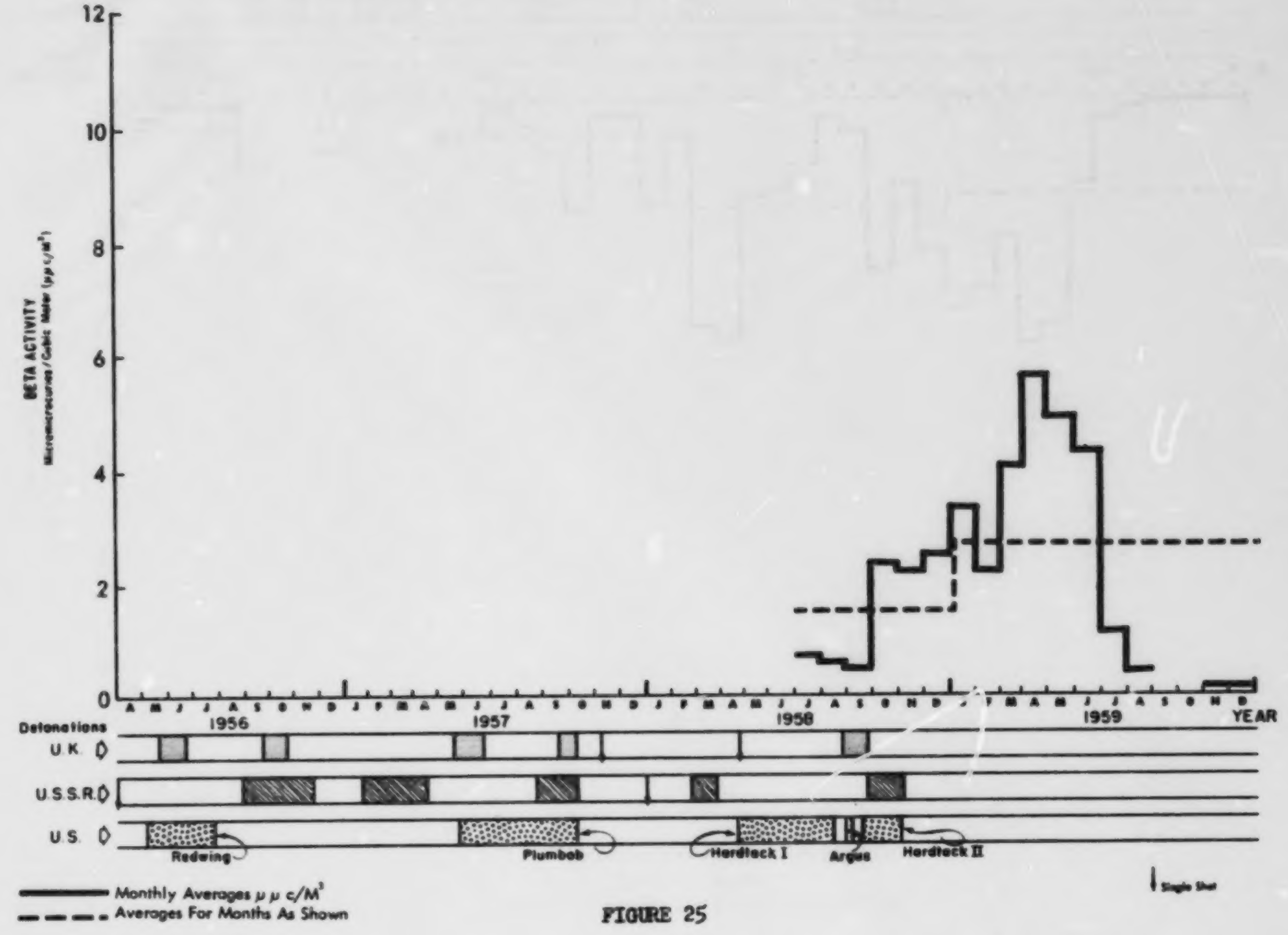


FIGURE 25

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Juneau, Alaska
Radiation Surveillance Network

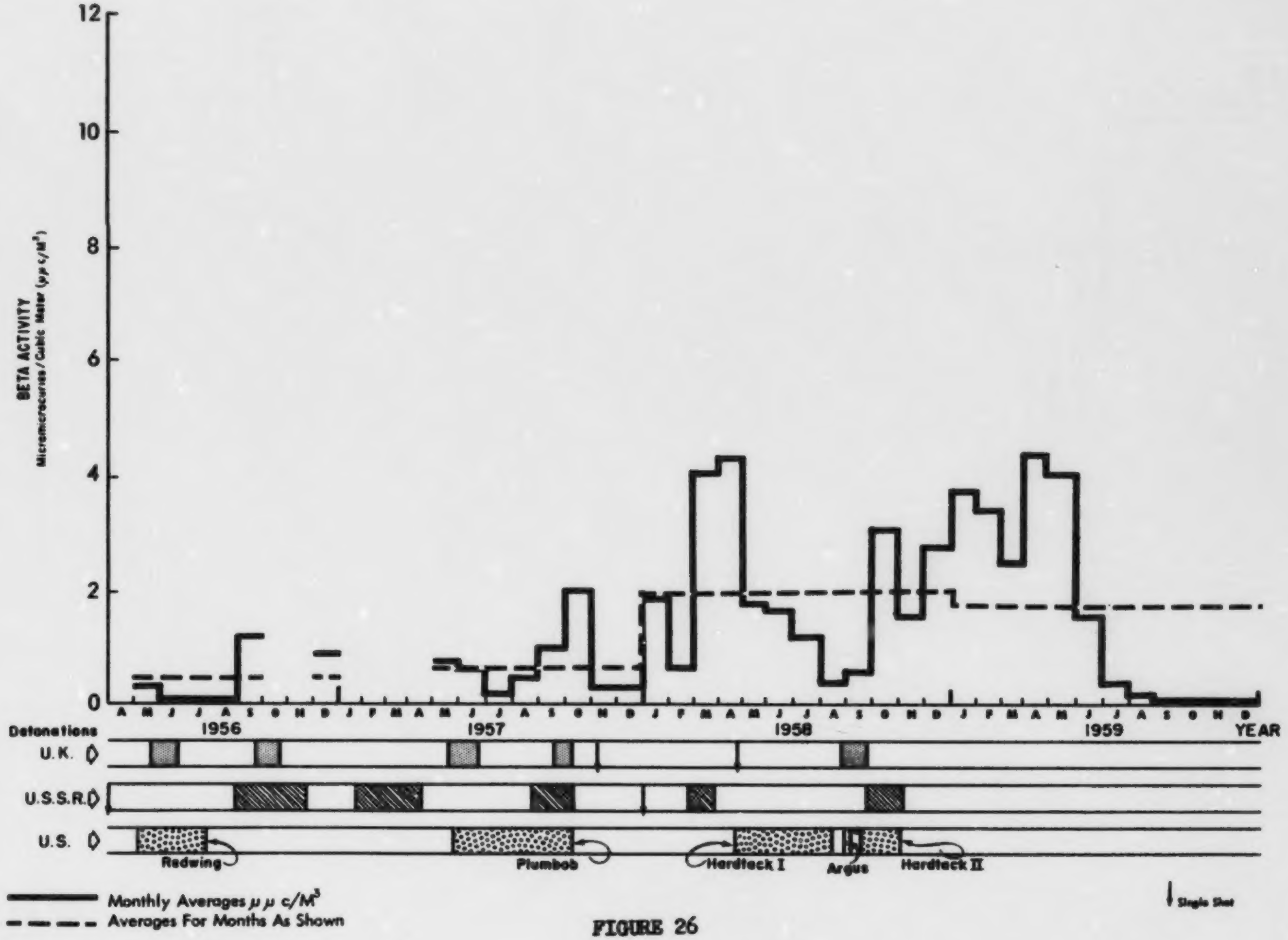


FIGURE 26

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Phoenix, Arizona
Radiation Surveillance Network

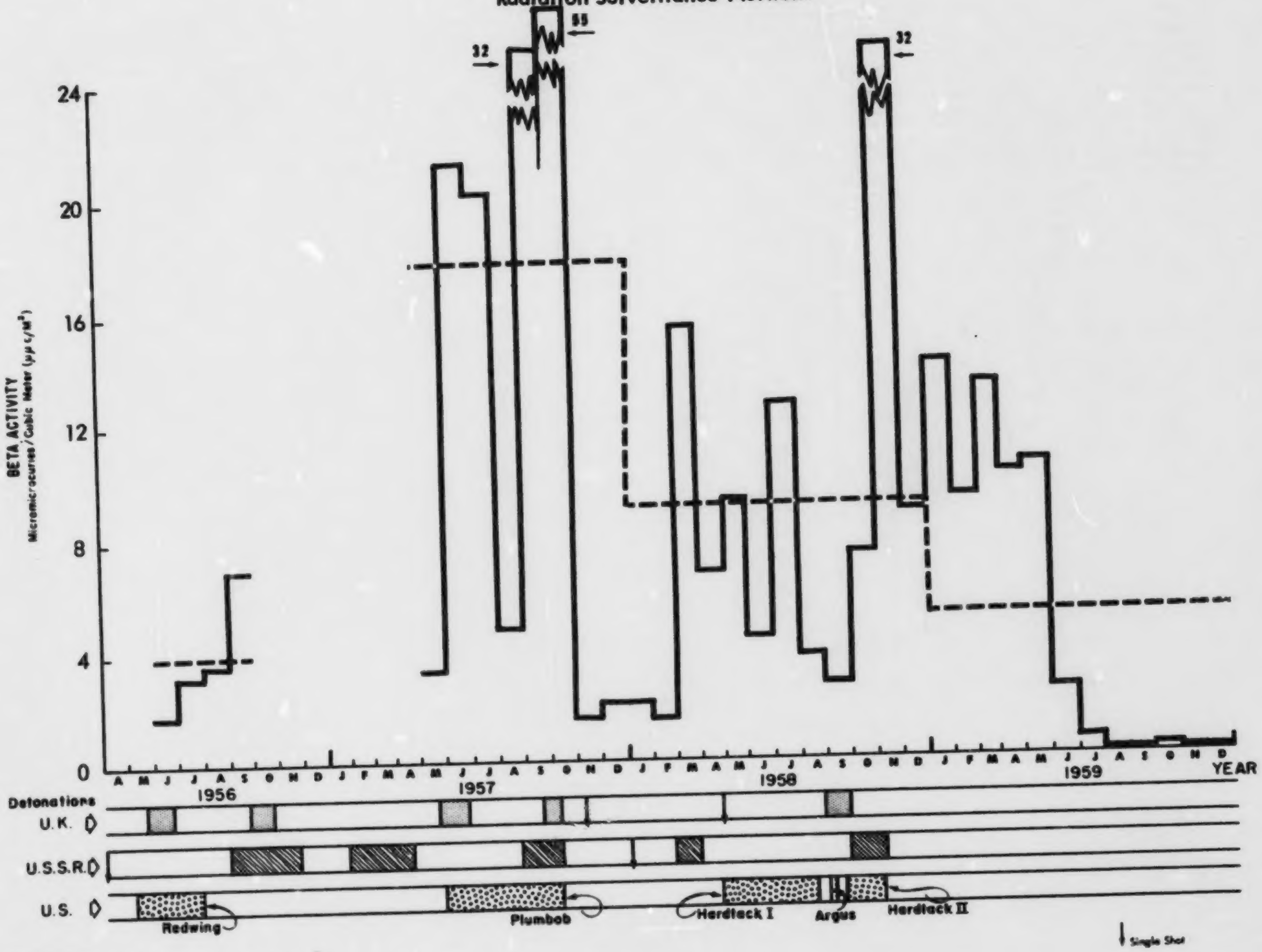


FIGURE 27

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Little Rock, Arkansas
Radiation Surveillance Network

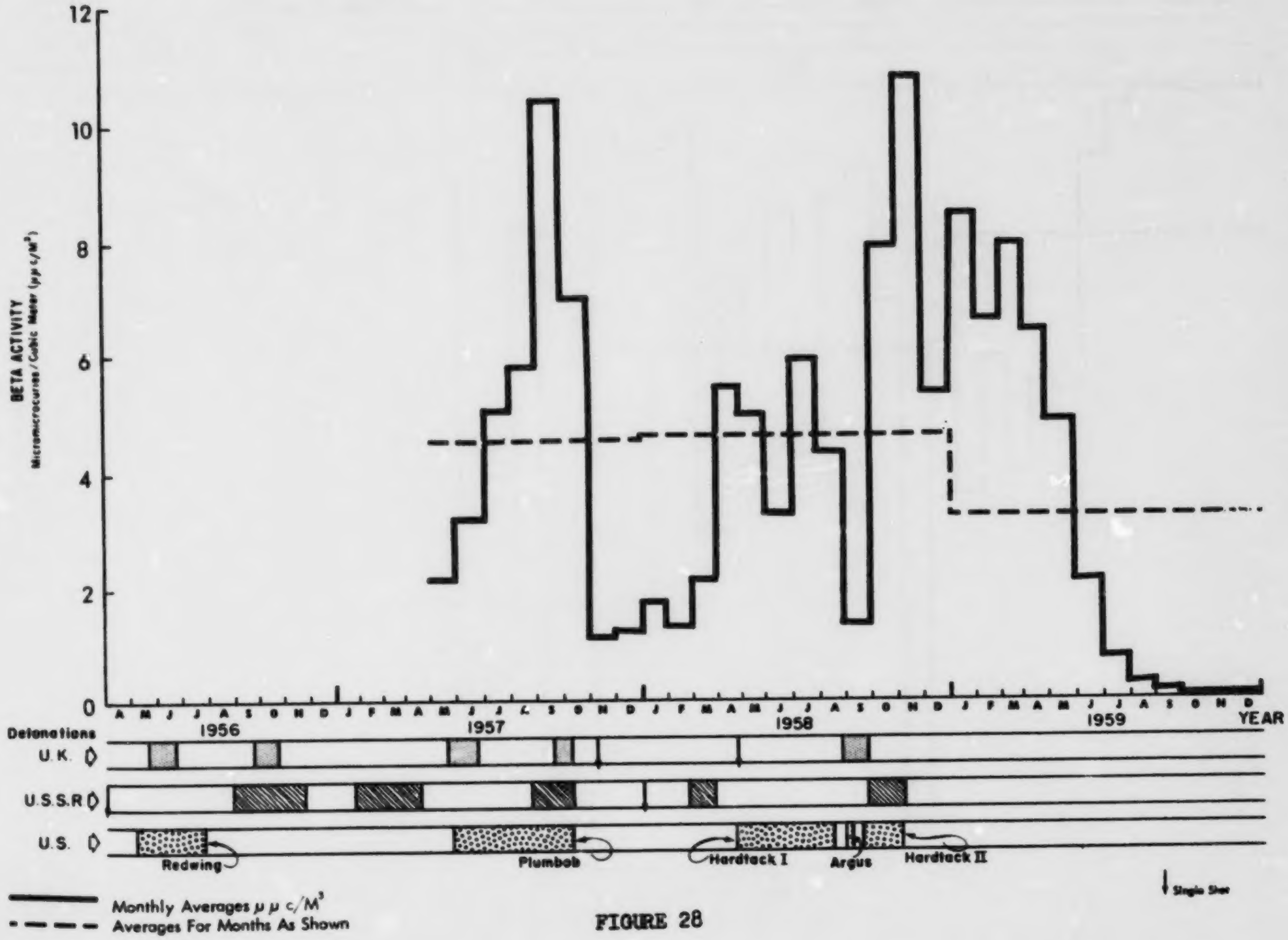


FIGURE 28

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Berkeley, California
Radiation Surveillance Network

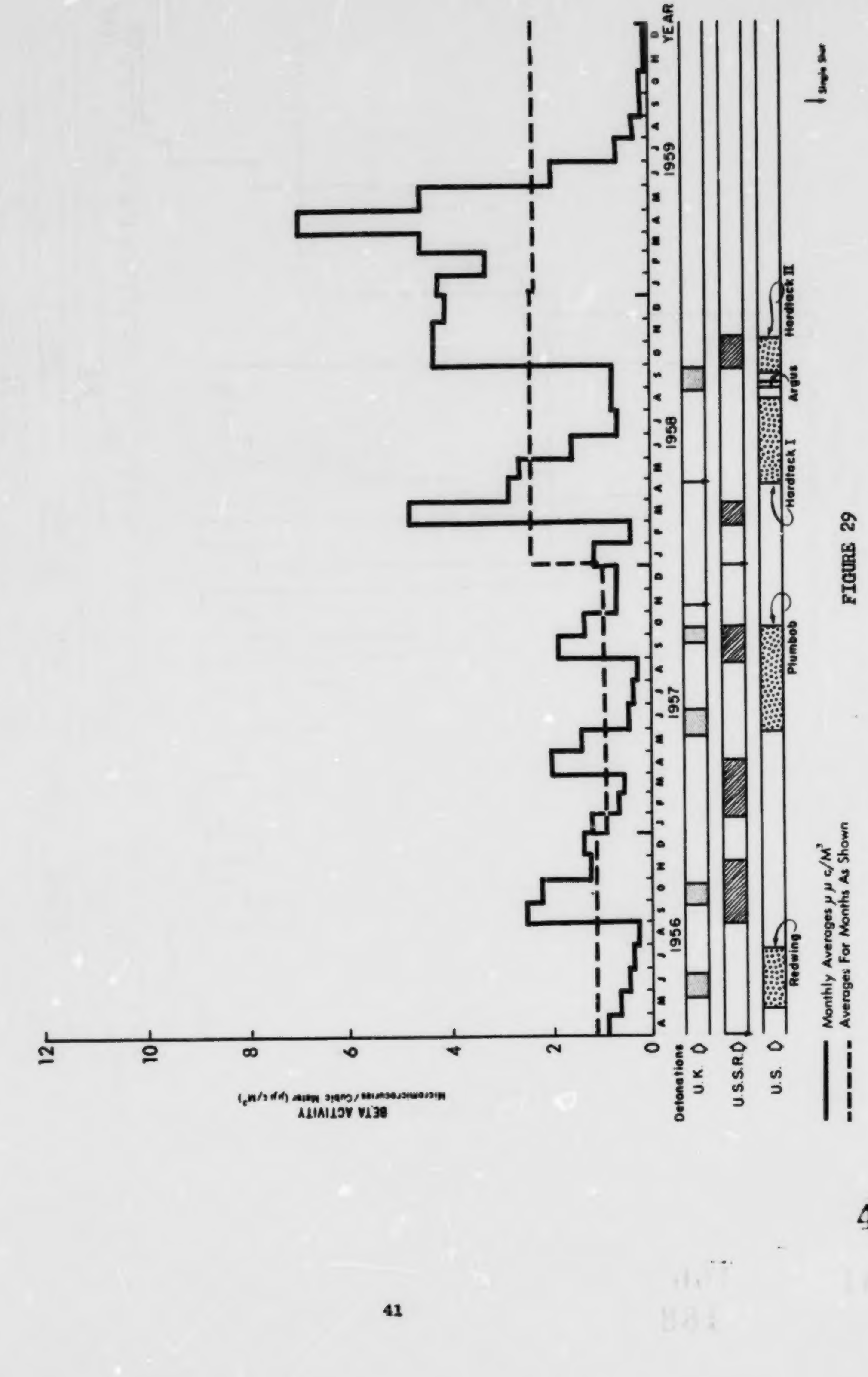


FIGURE 29

46<

47<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Los Angeles, California
Radiation Surveillance Network

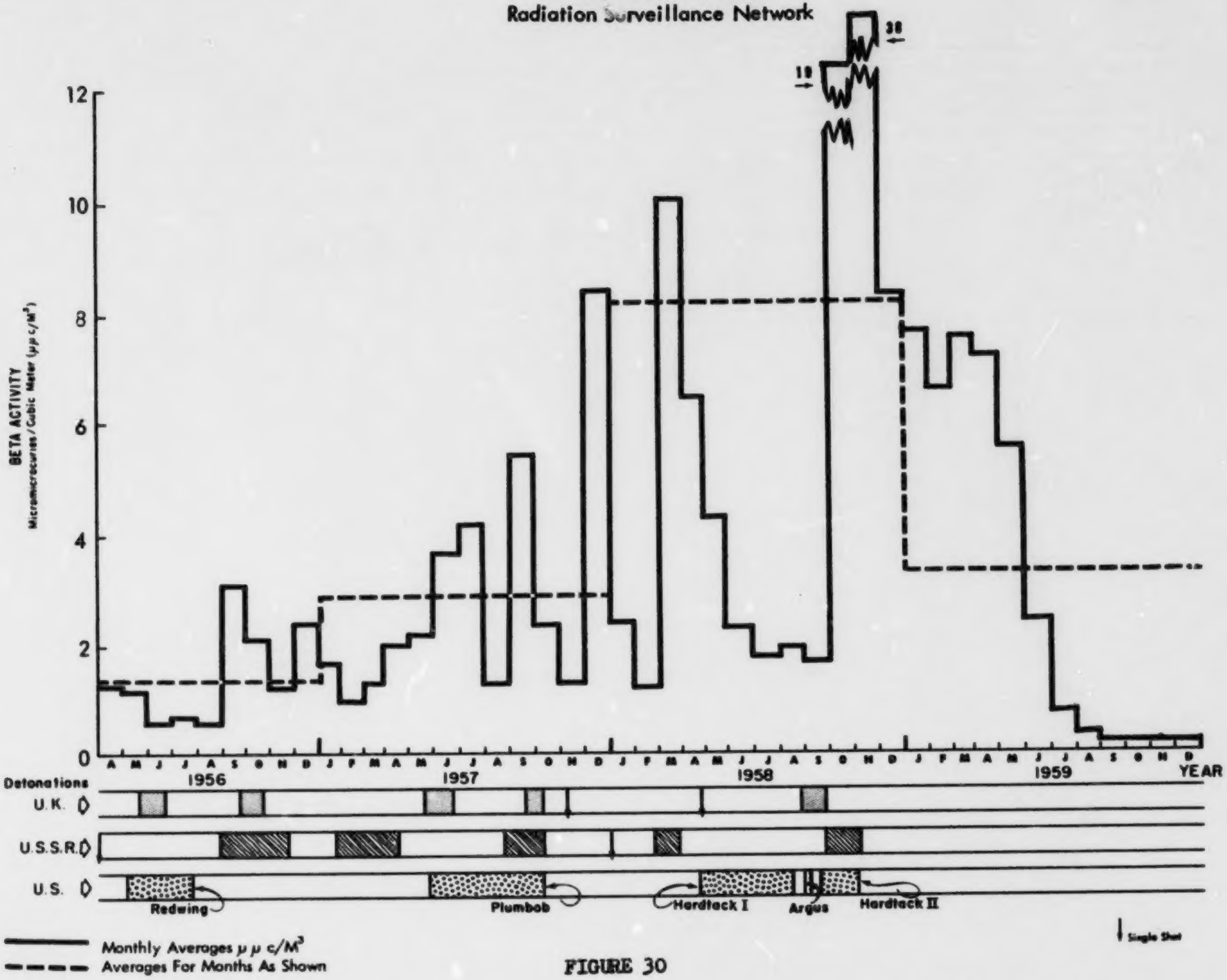


FIGURE 30

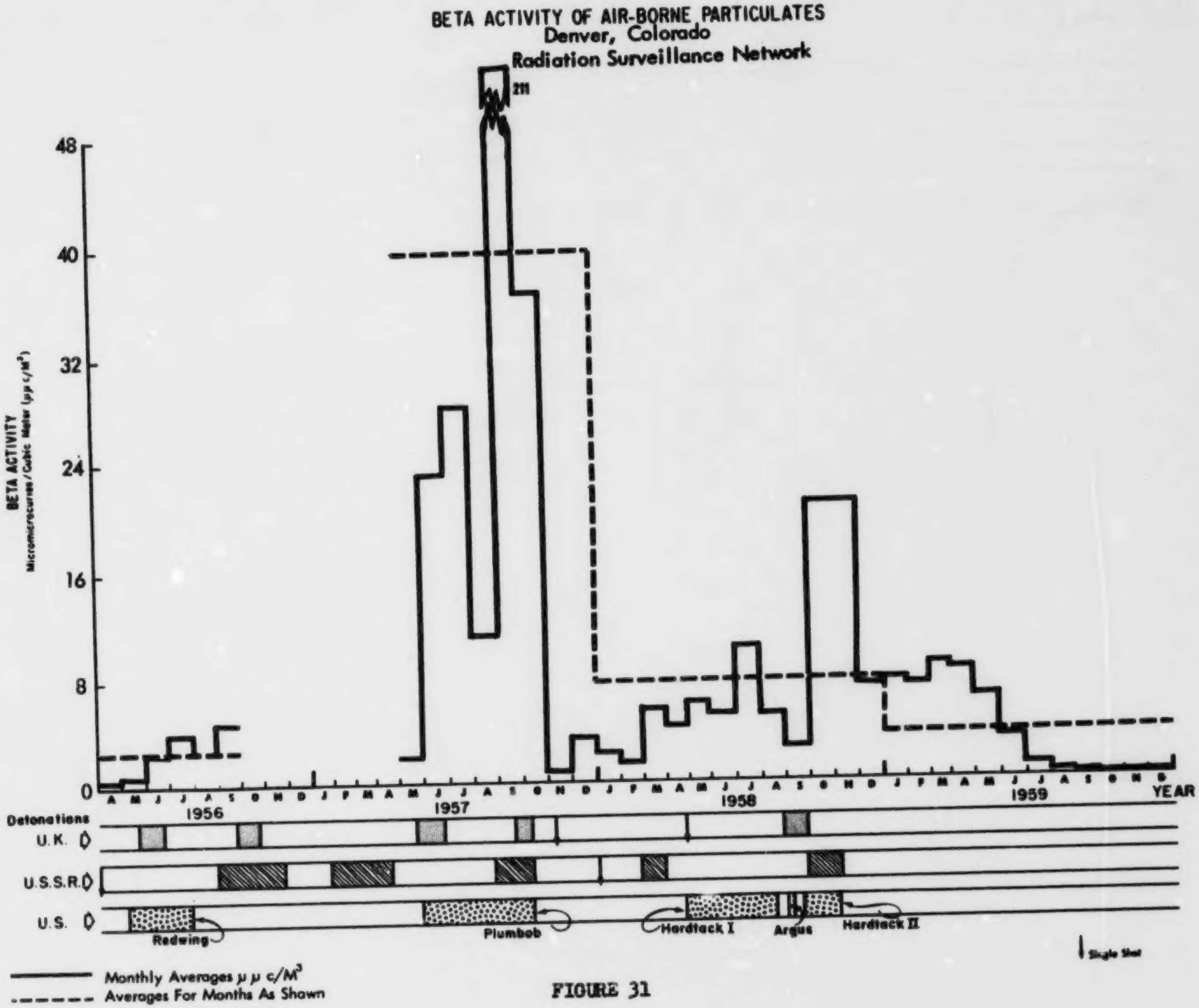

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Denver, Colorado
Radiation Surveillance Network

FIGURE 31

48<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Hartford, Connecticut
Radiation Surveillance Network

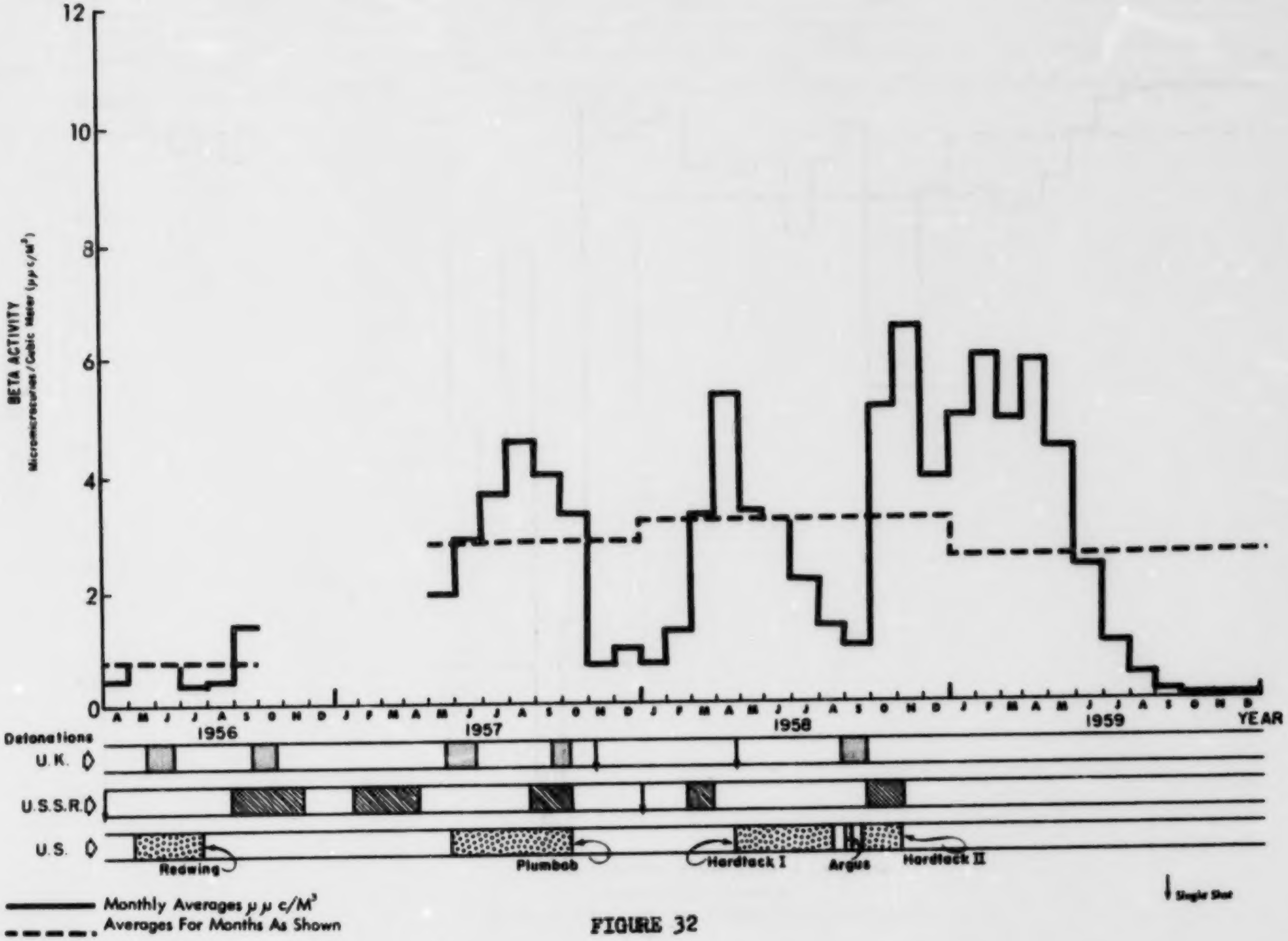


FIGURE 32

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Washington, D. C.
Radiation Surveillance Network

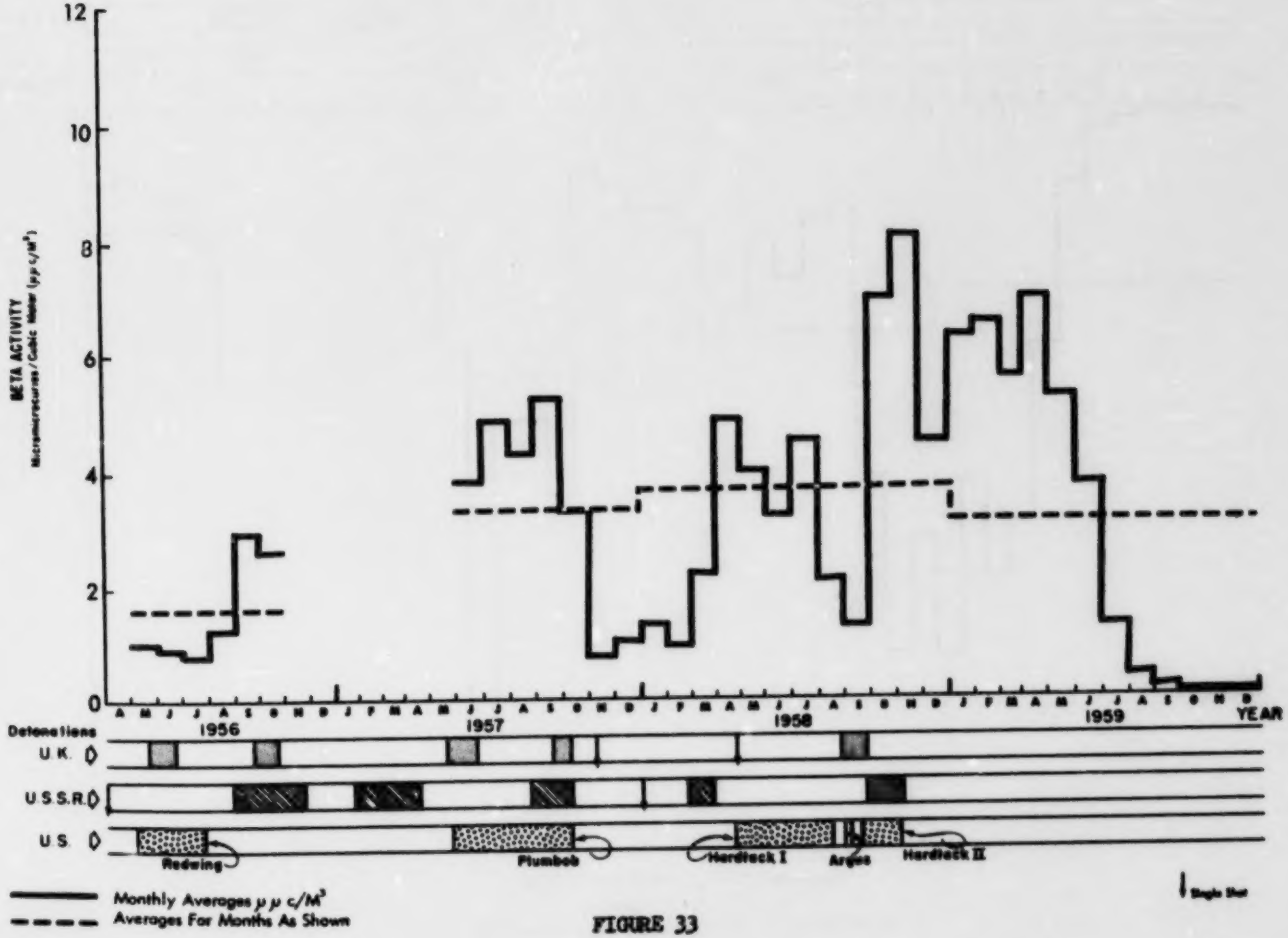


FIGURE 33

50<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Jacksonville, Florida
Radiation Surveillance Network

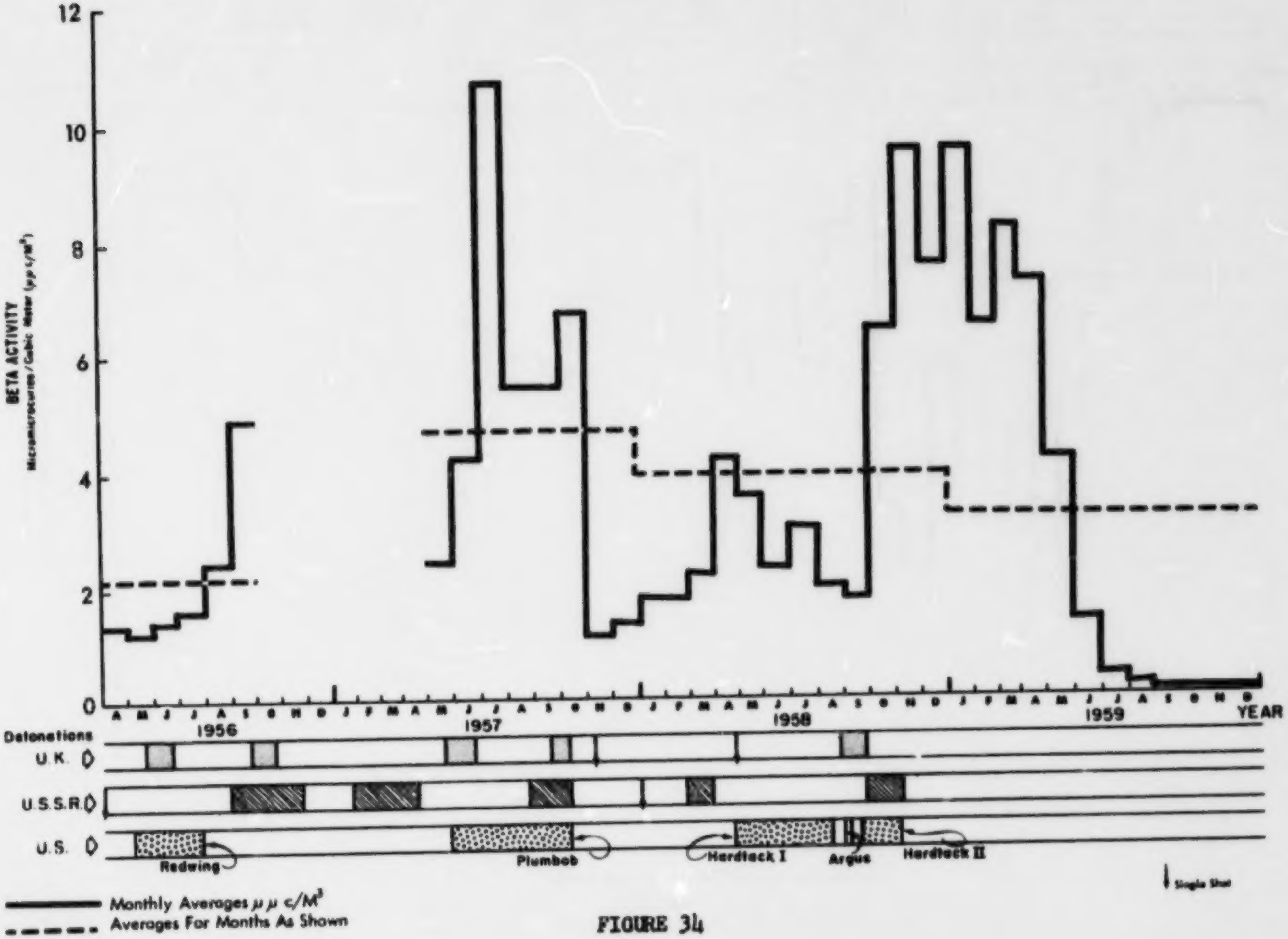


FIGURE 34

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Atlanta, Georgia
Radiation Surveillance Network

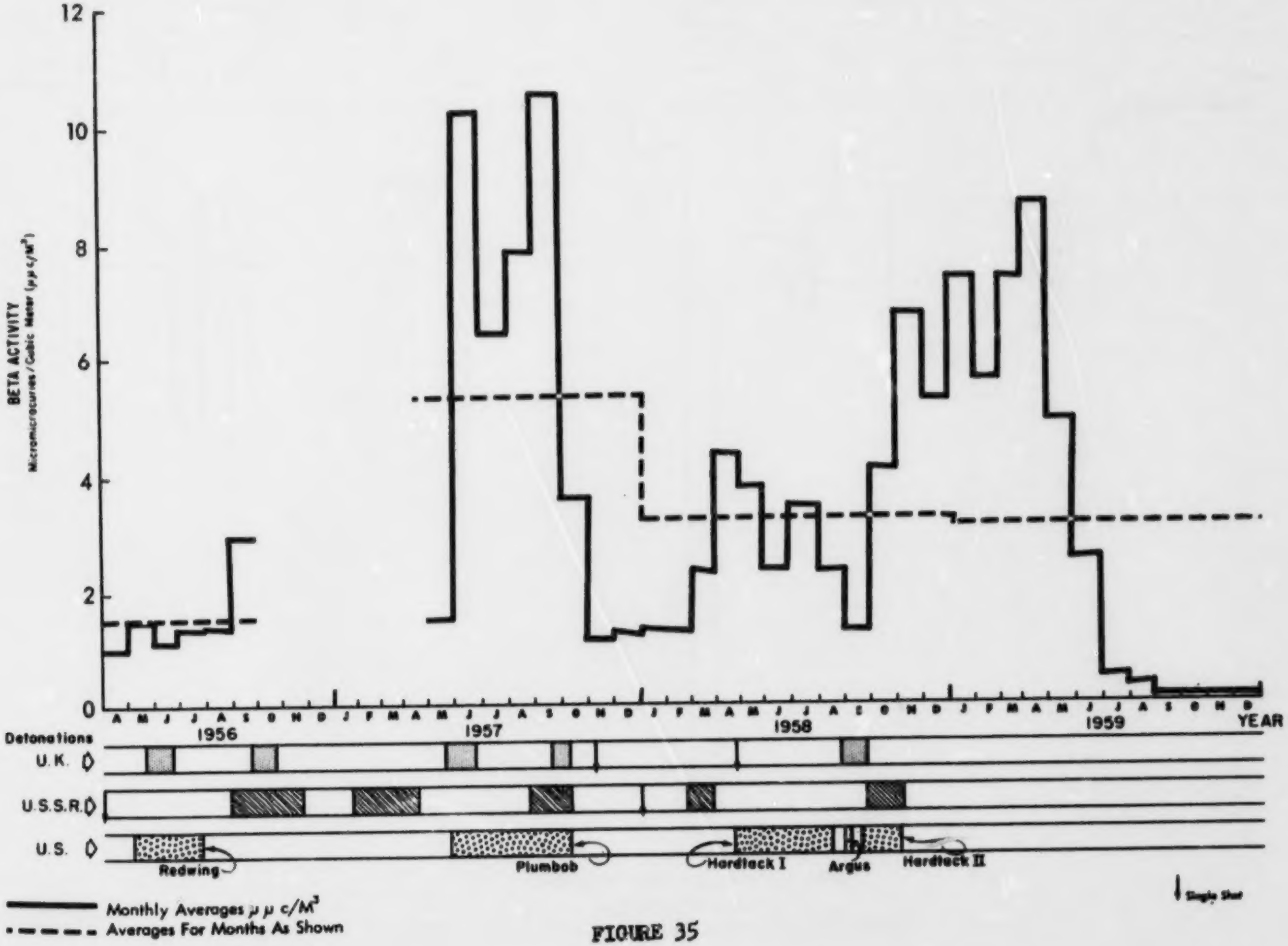


FIGURE 35

52<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Honolulu, Hawaii
Radiation Surveillance Network

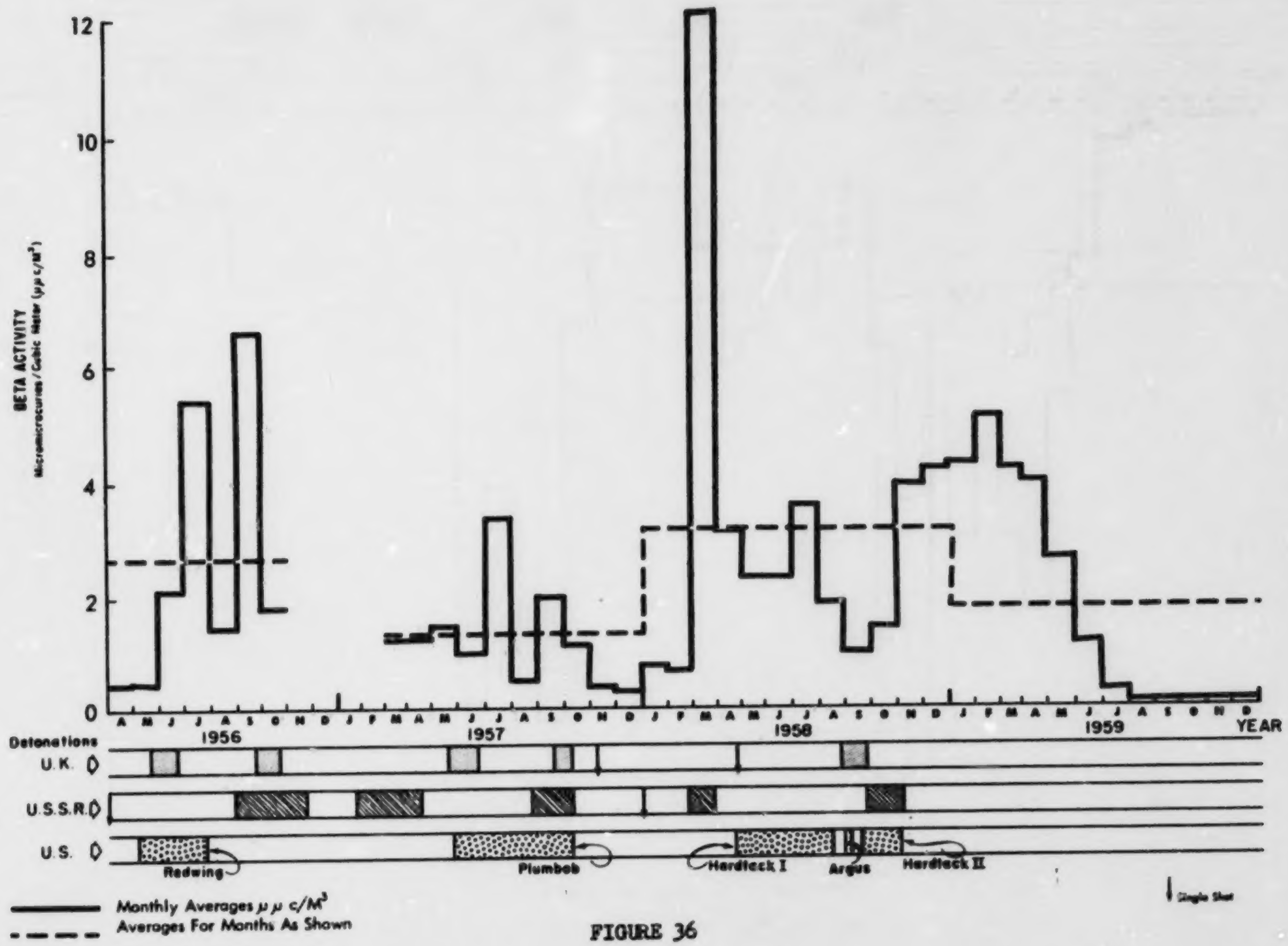


FIGURE 36

53

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Boise, Idaho
Radiation Surveillance Network

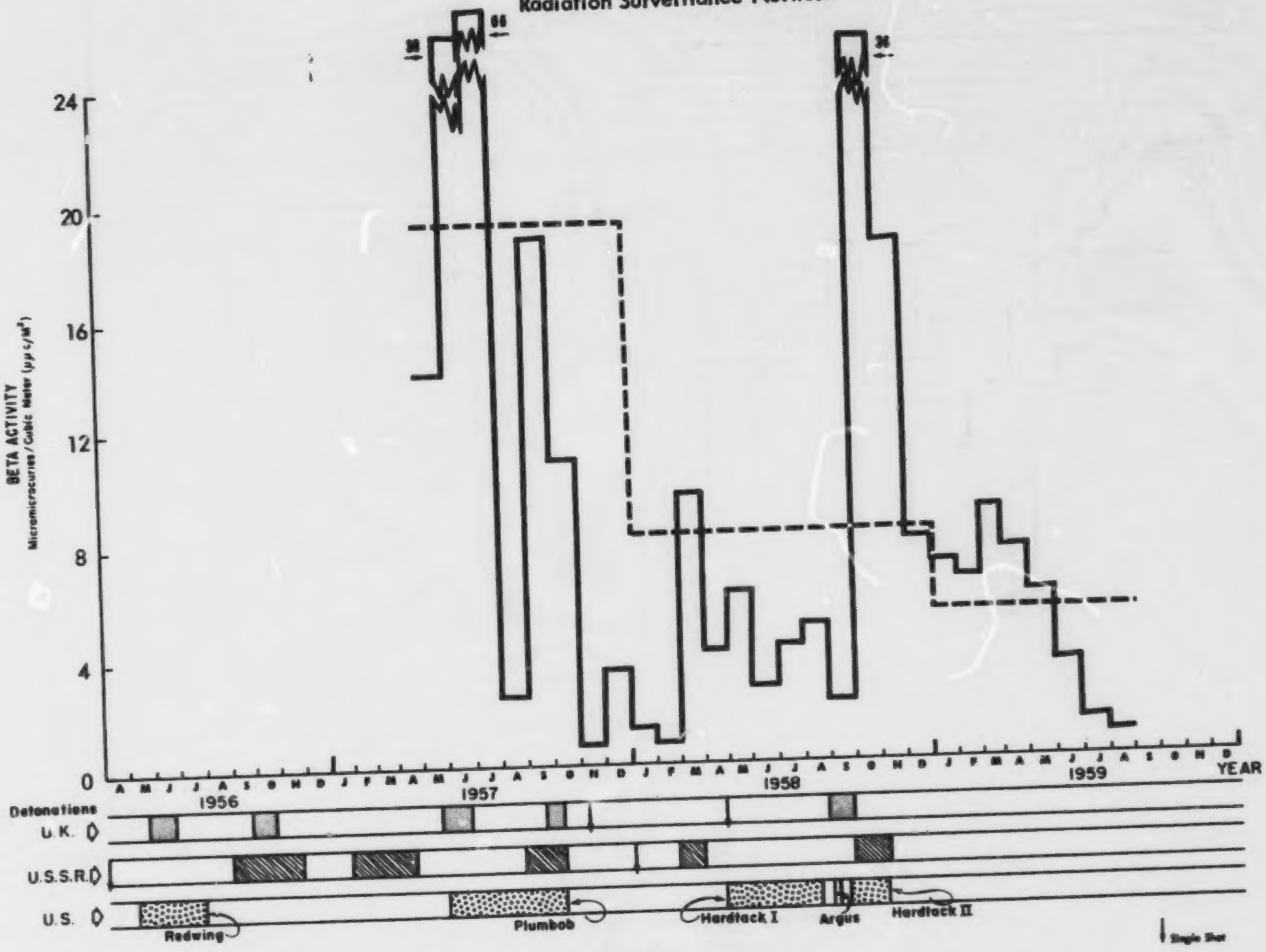


FIGURE 37

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Springfield, Illinois
Radiation Surveillance Network

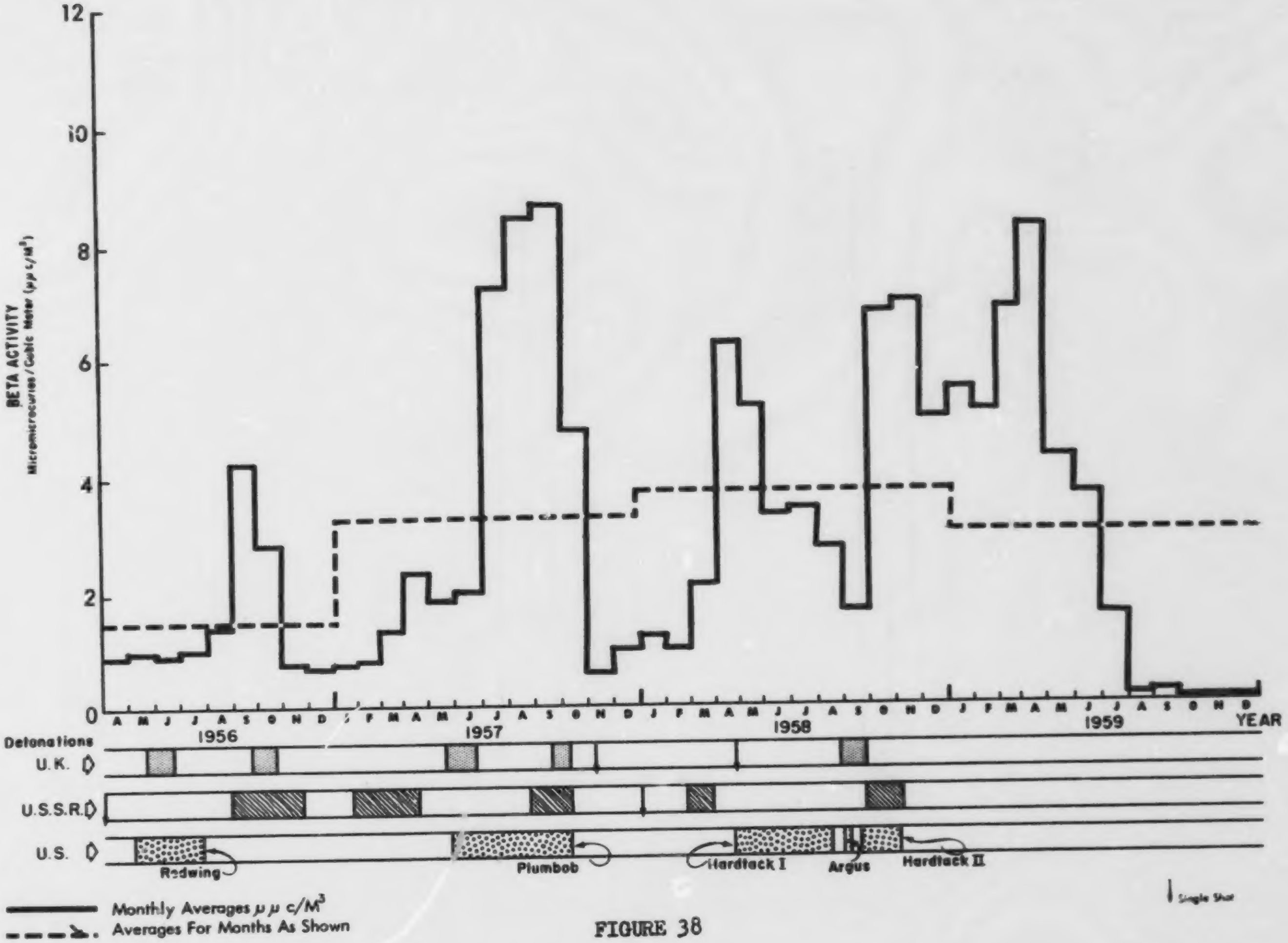


FIGURE 38

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Indianapolis, Indiana
Radiation Surveillance Network

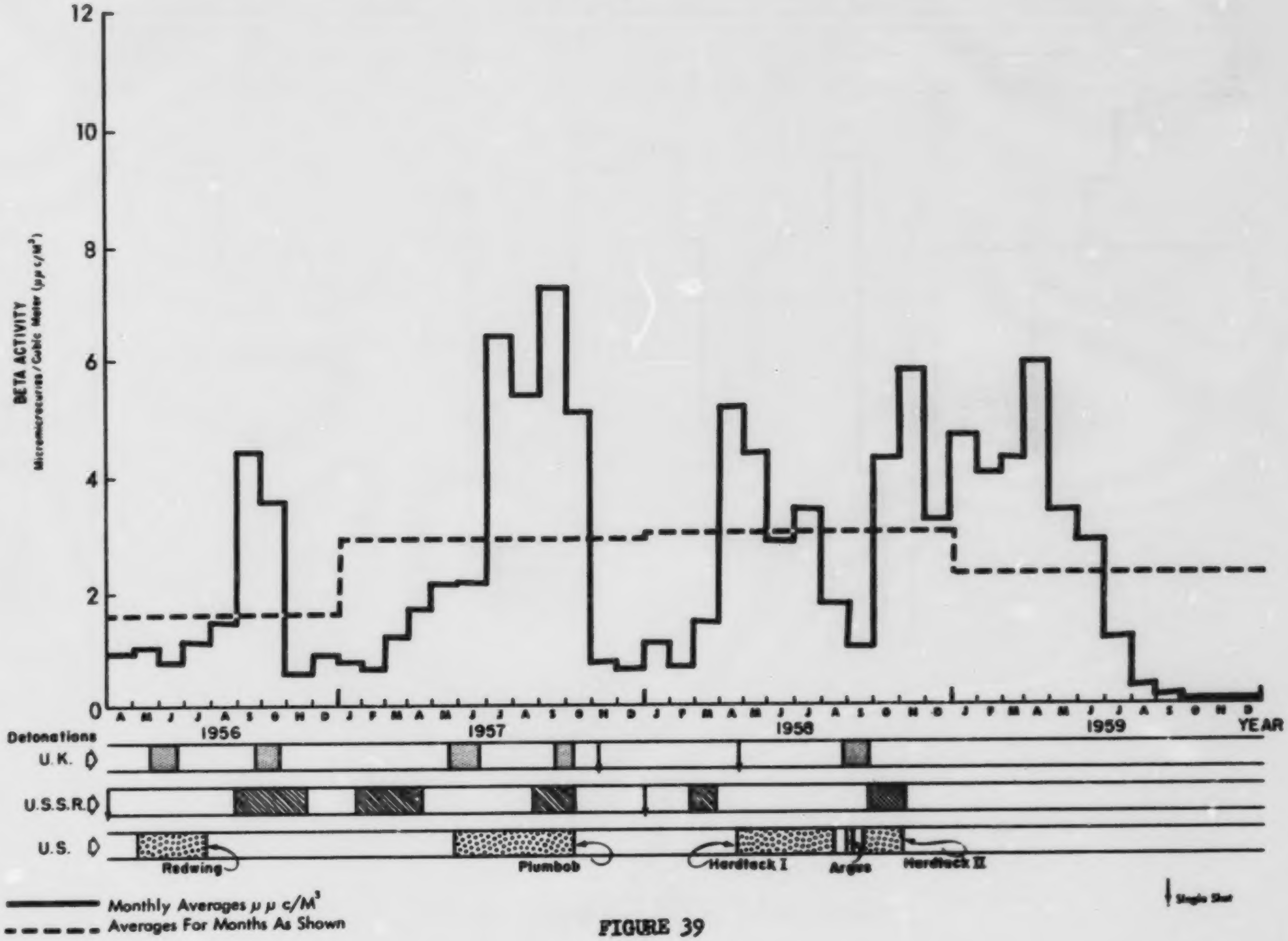


FIGURE 39

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Iowa City, Iowa
Radiation Surveillance Network

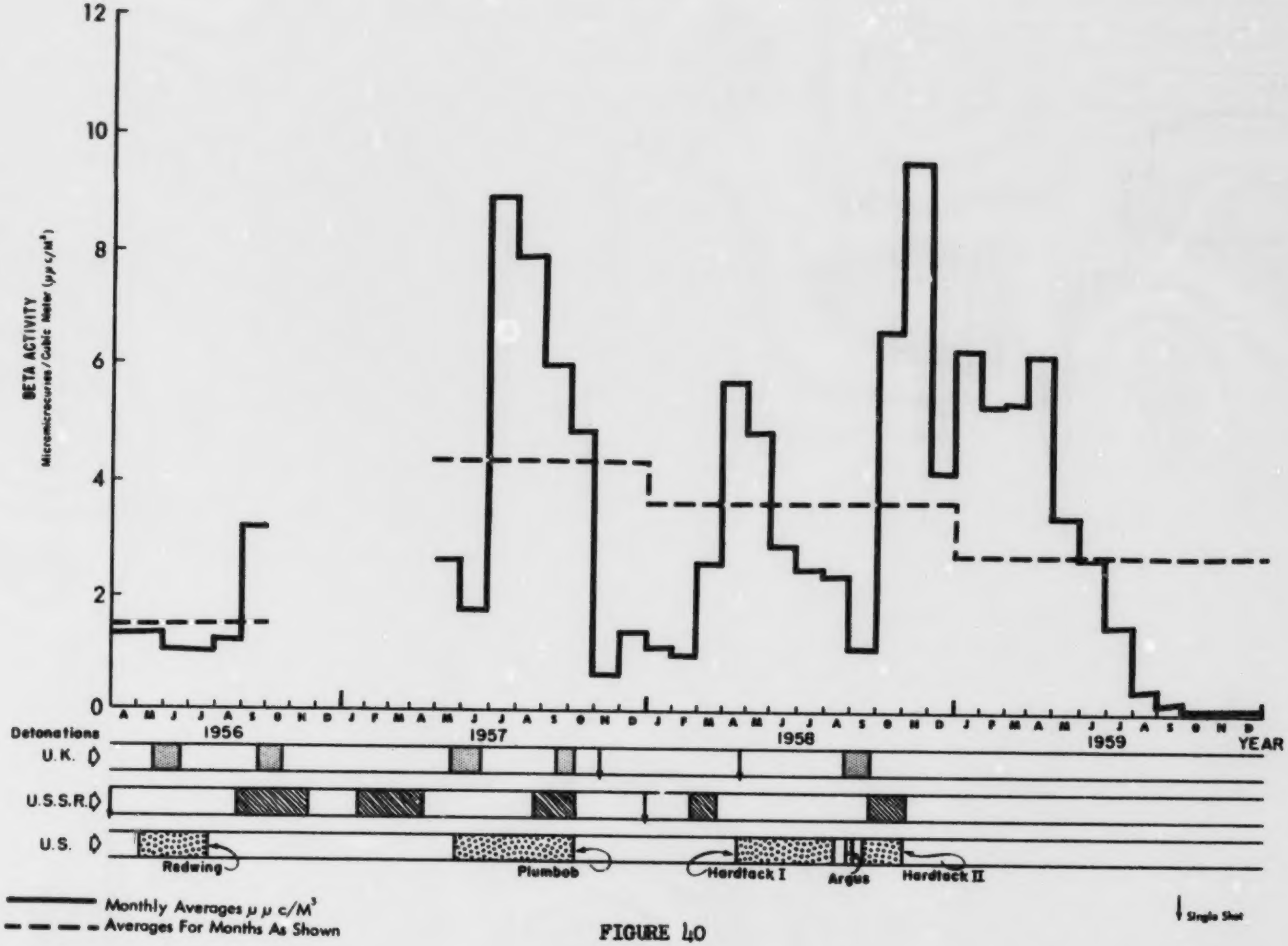


FIGURE 40

57

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Topeka, Kansas
Radiation Surveillance Network

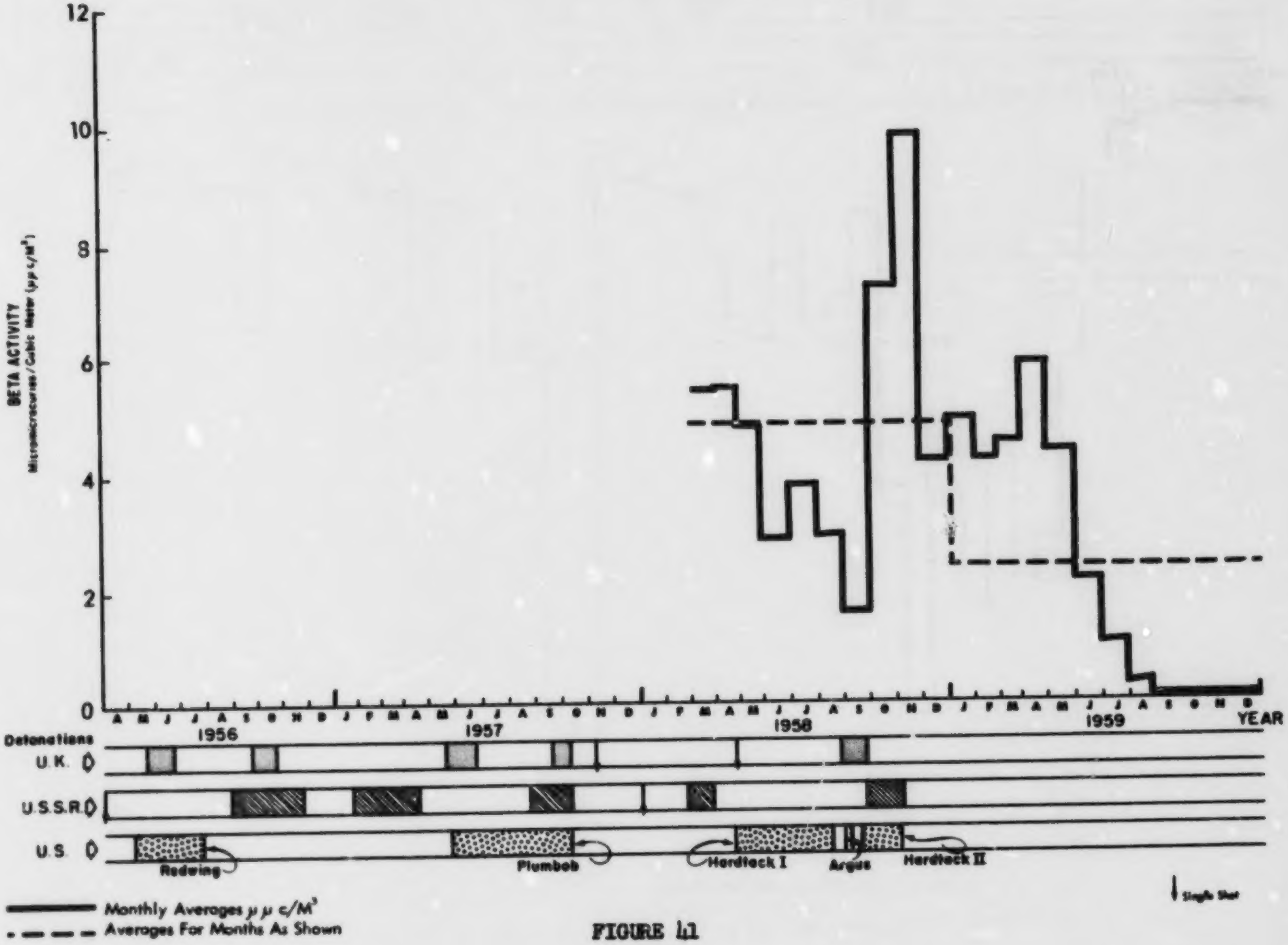


FIGURE 41

59<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
New Orleans, Louisiana
RADIATION SURVEILLANCE NETWORK

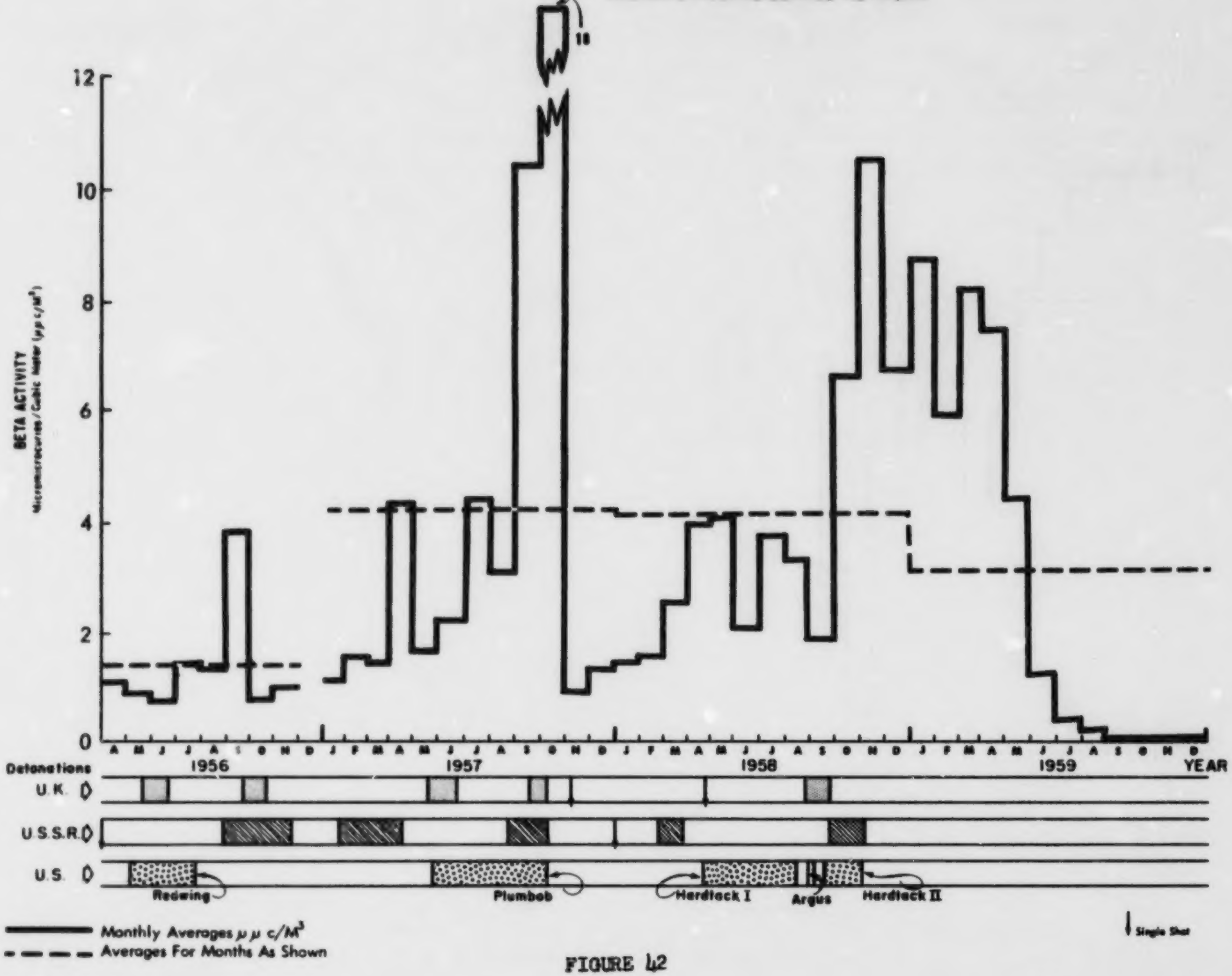


FIGURE 42

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Baltimore, Maryland
Radiation Surveillance Network

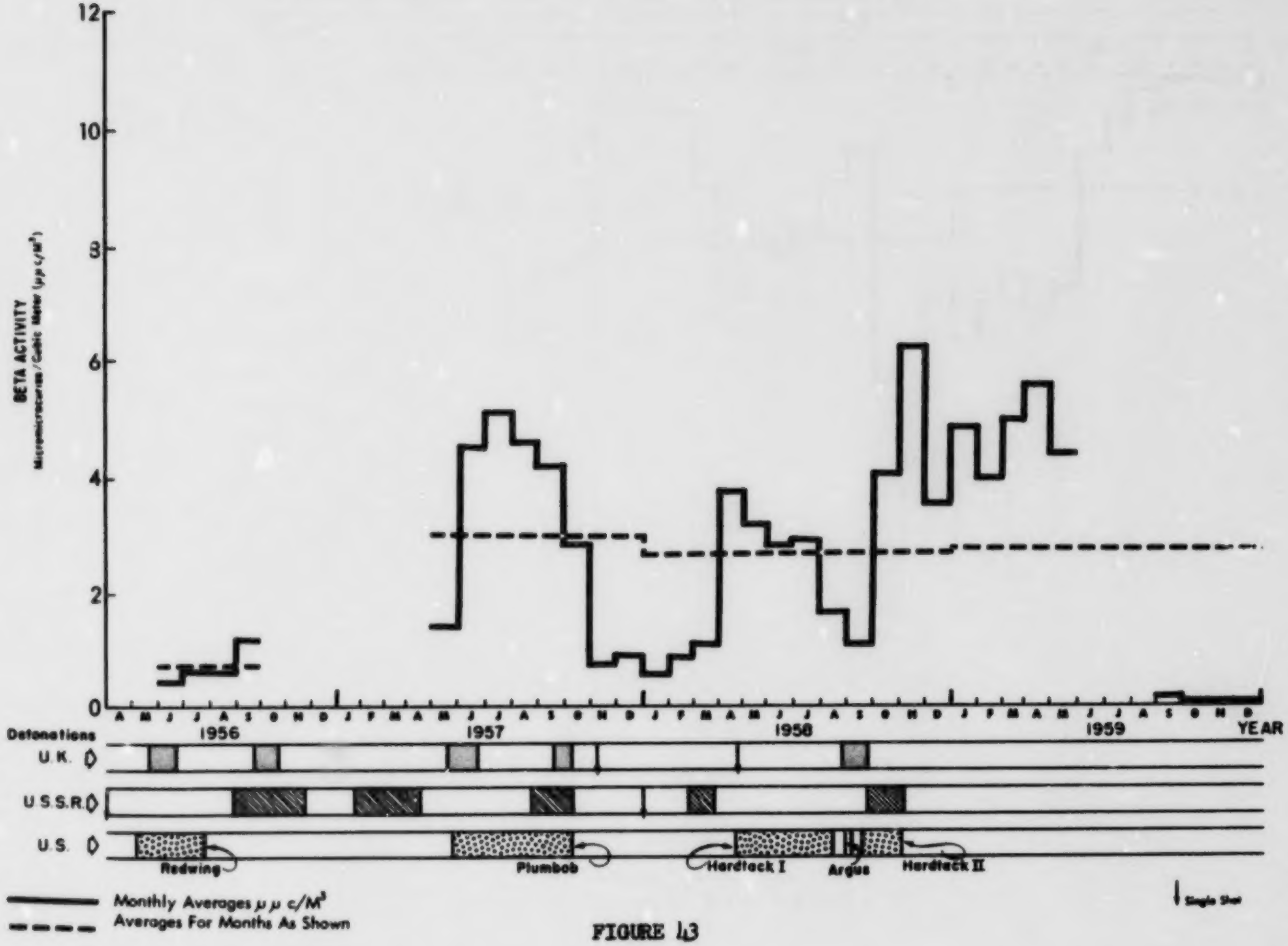


FIGURE 43

60<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Lawrence, Massachusetts

Radiation Surveillance Network

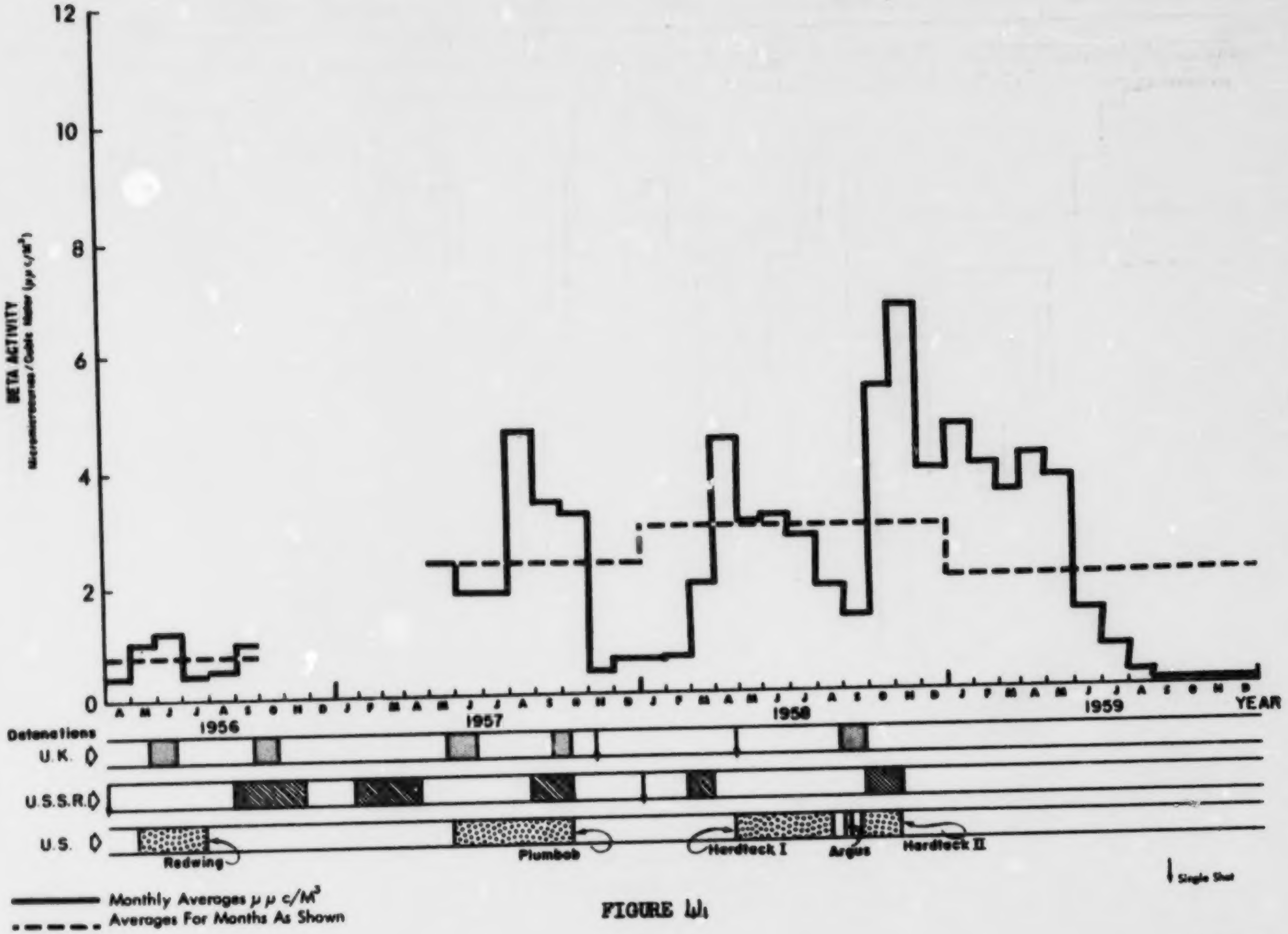


FIGURE 41

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Lansing, Michigan
Radiation Surveillance Network

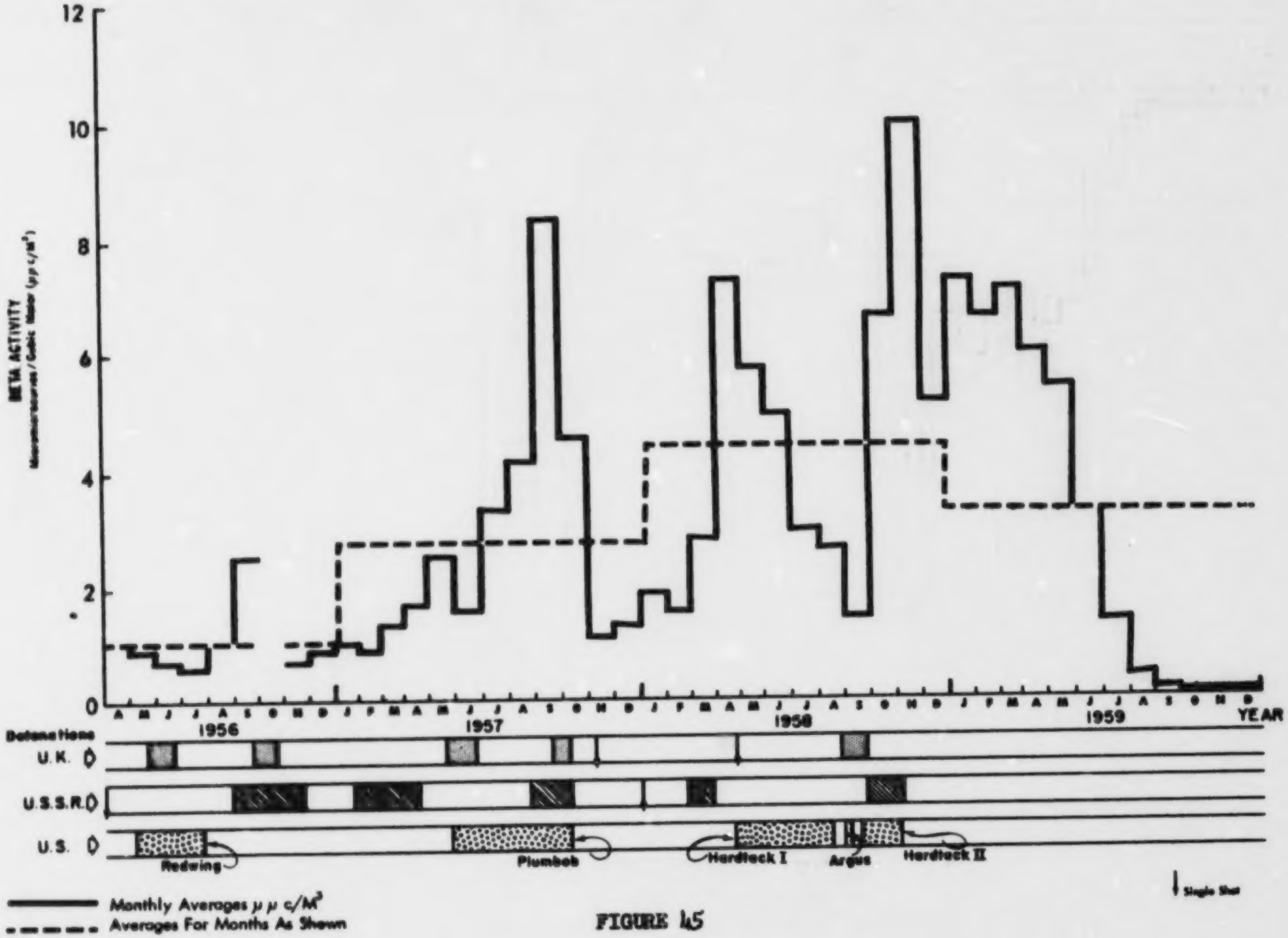


FIGURE 45

62<

63<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Minneapolis, Minnesota
Radiation Surveillance Network

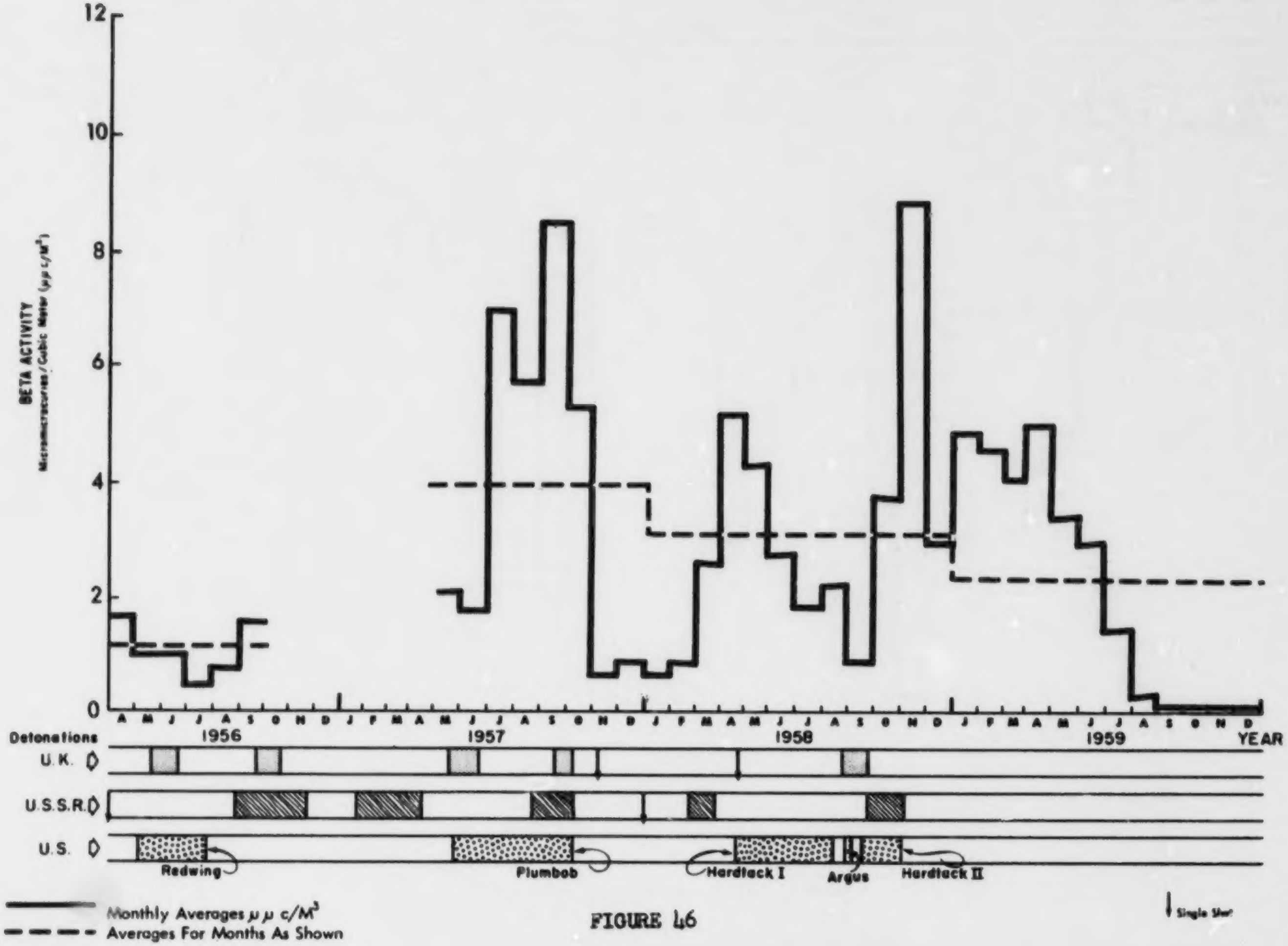


FIGURE 46

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Pascagoula, Mississippi
Radiation Surveillance Network

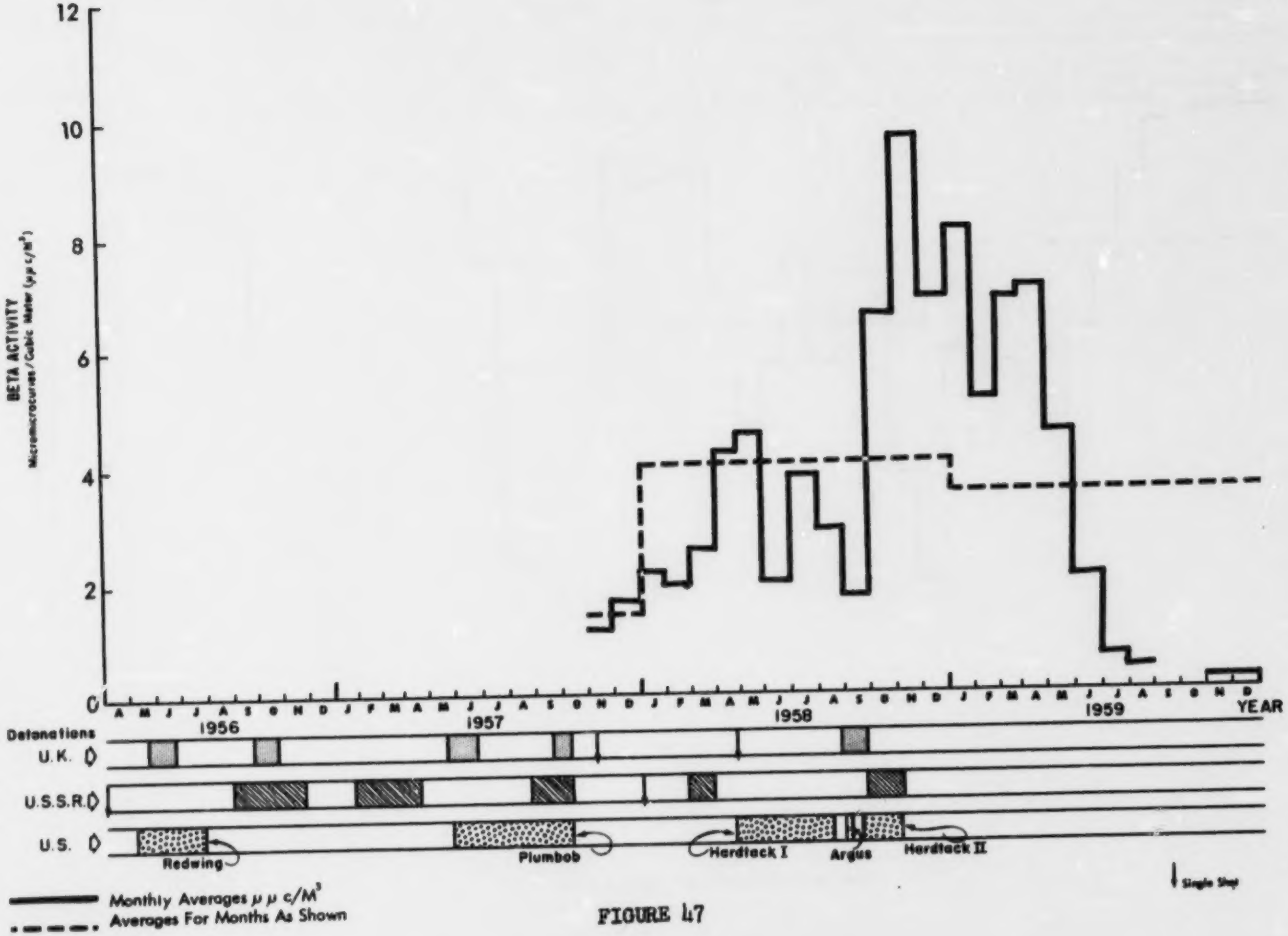


FIGURE 47

65<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Jefferson City, Missouri
Radiation Surveillance Network

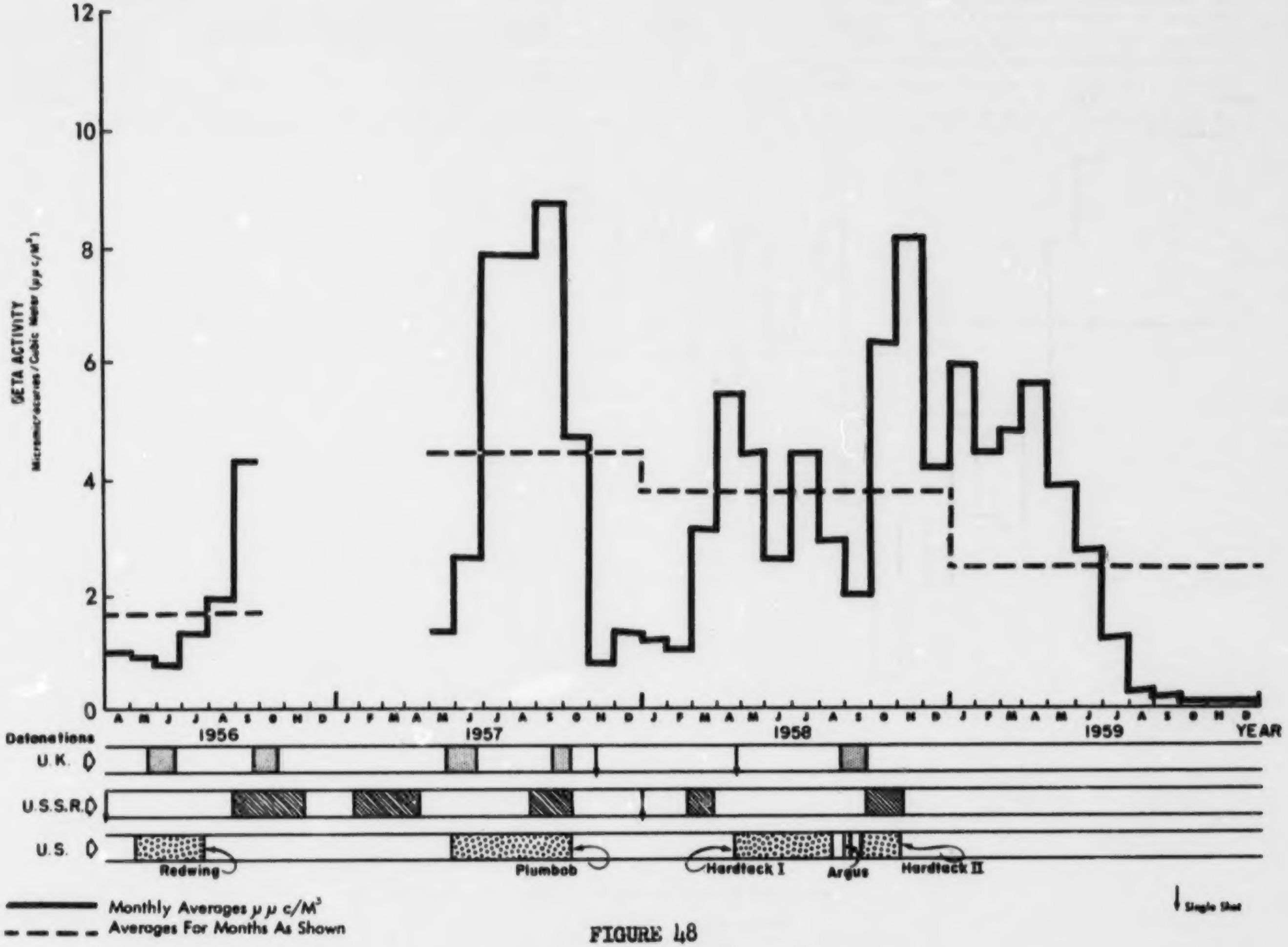


FIGURE 48

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Helena, Montana
Radiation Surveillance Network

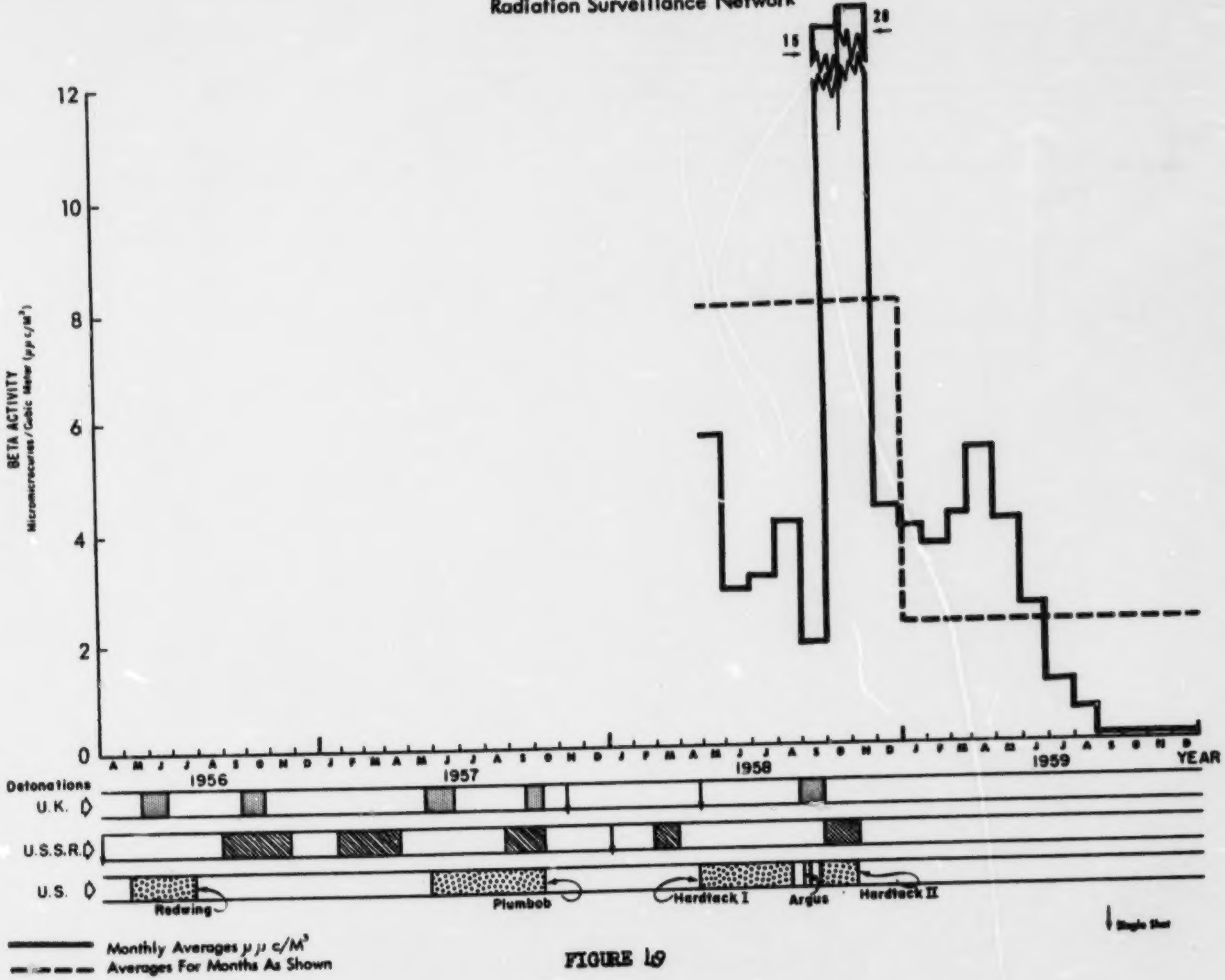


FIGURE 19

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Trenton, New Jersey
Radiation Surveillance Network

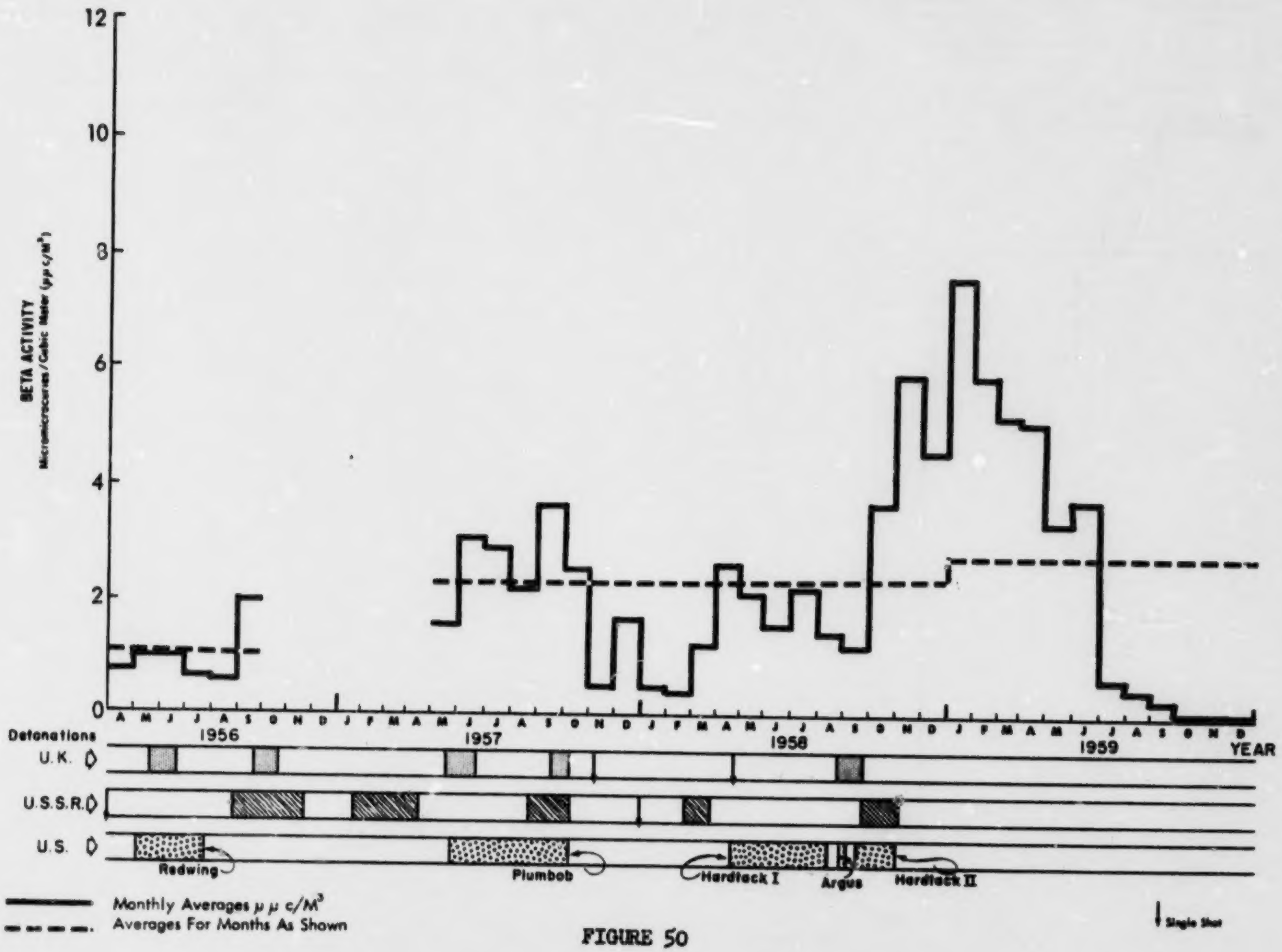


FIGURE 50

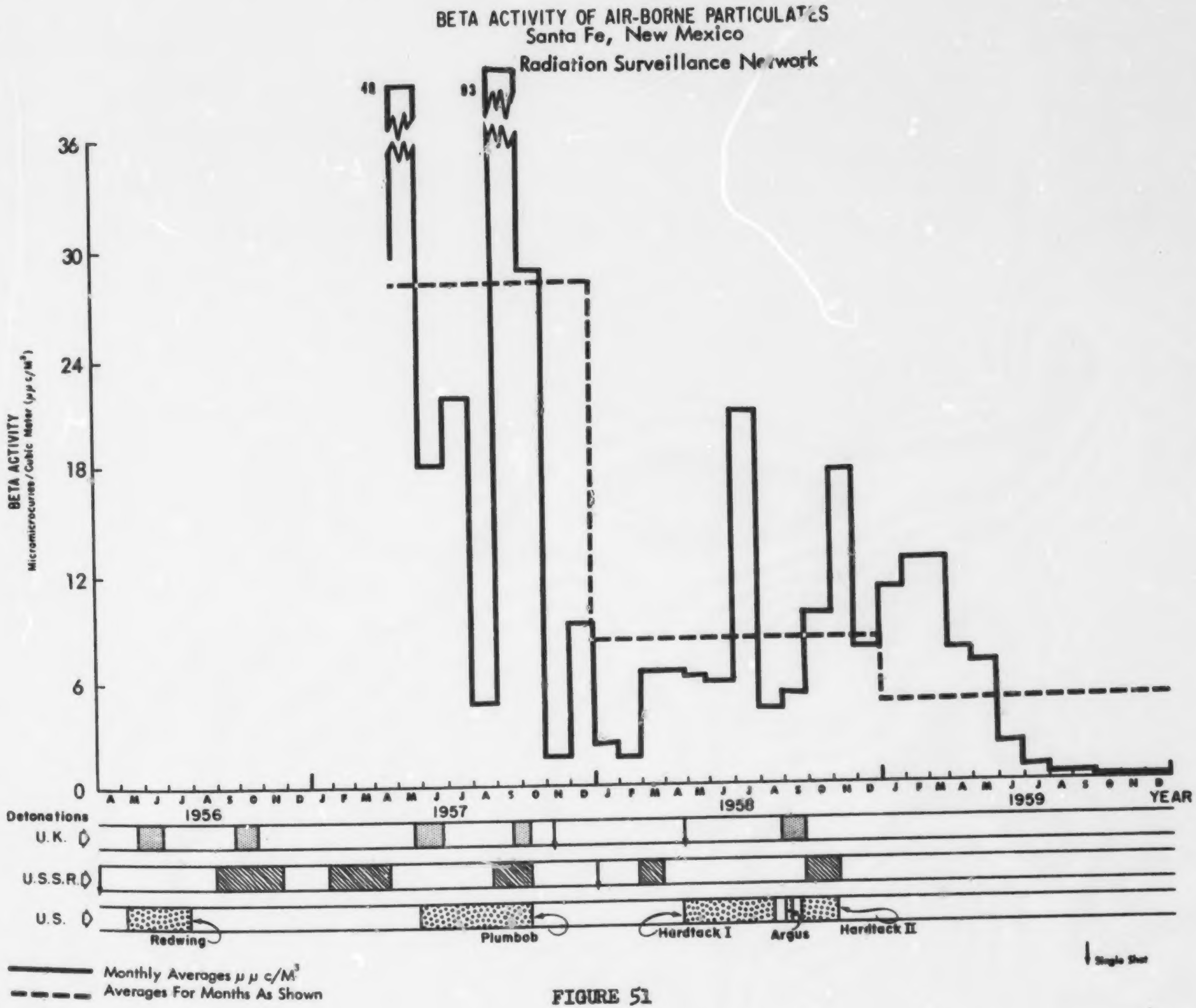

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Santa Fe, New Mexico
Radiation Surveillance Network
BETA ACTIVITY
Micromicrocuries/Cubic Meter (μμ c/M³)
48
93
36
30
24
18
12
6
0
A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1956
1957
1958
1959
YEAR
Detonations
U.K.
U.S.S.R.
U.S.
Redwing
Plumbob
Hardtack I
Argus
Hardtack II
Single Shot
Monthly Averages μ μ c/M³
Averages For Months As Shown

FIGURE 51

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Albany, New York
Radiation Surveillance Network

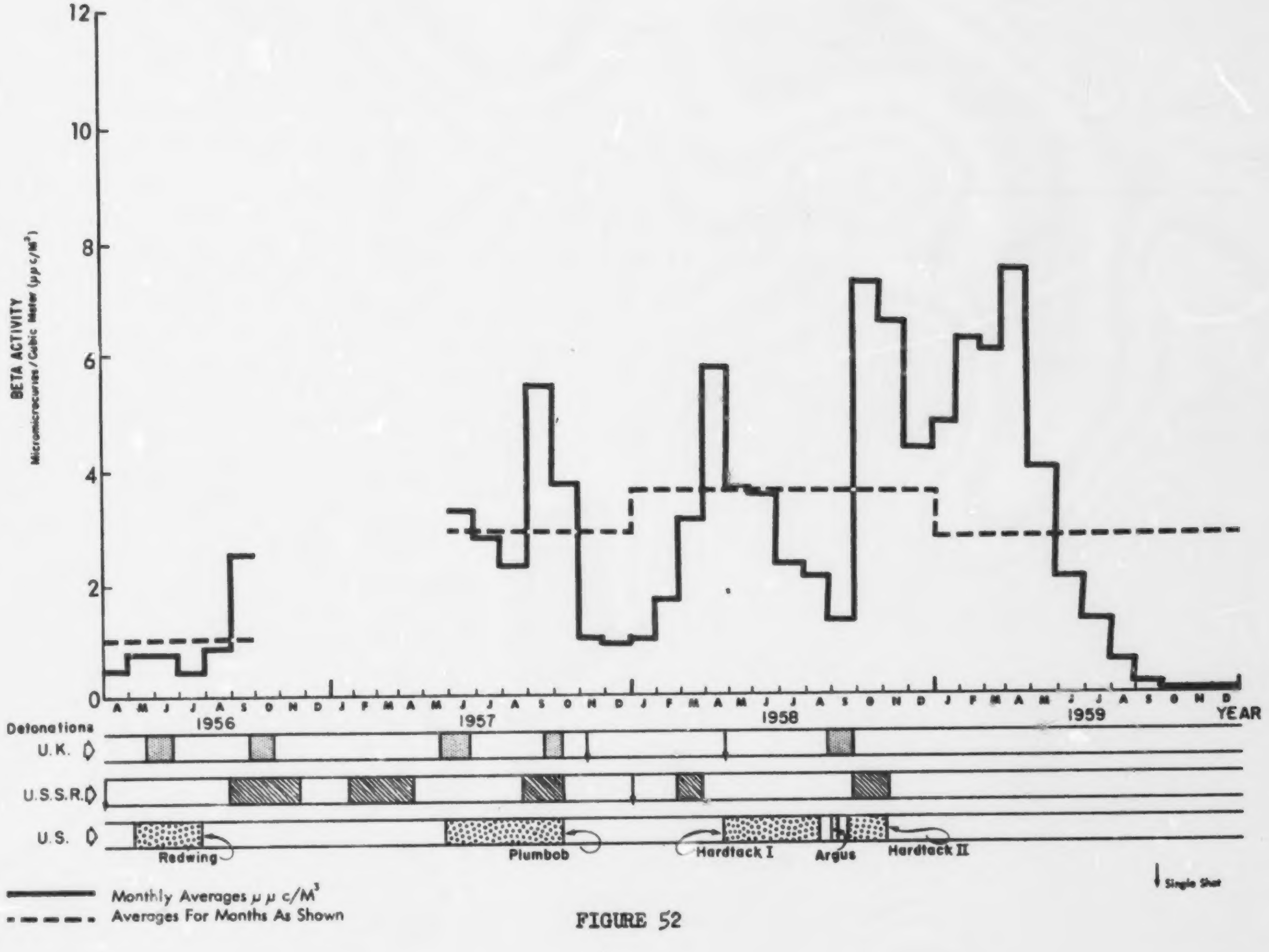


FIGURE 52

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Gastonia, North Carolina
Radiation Surveillance Network

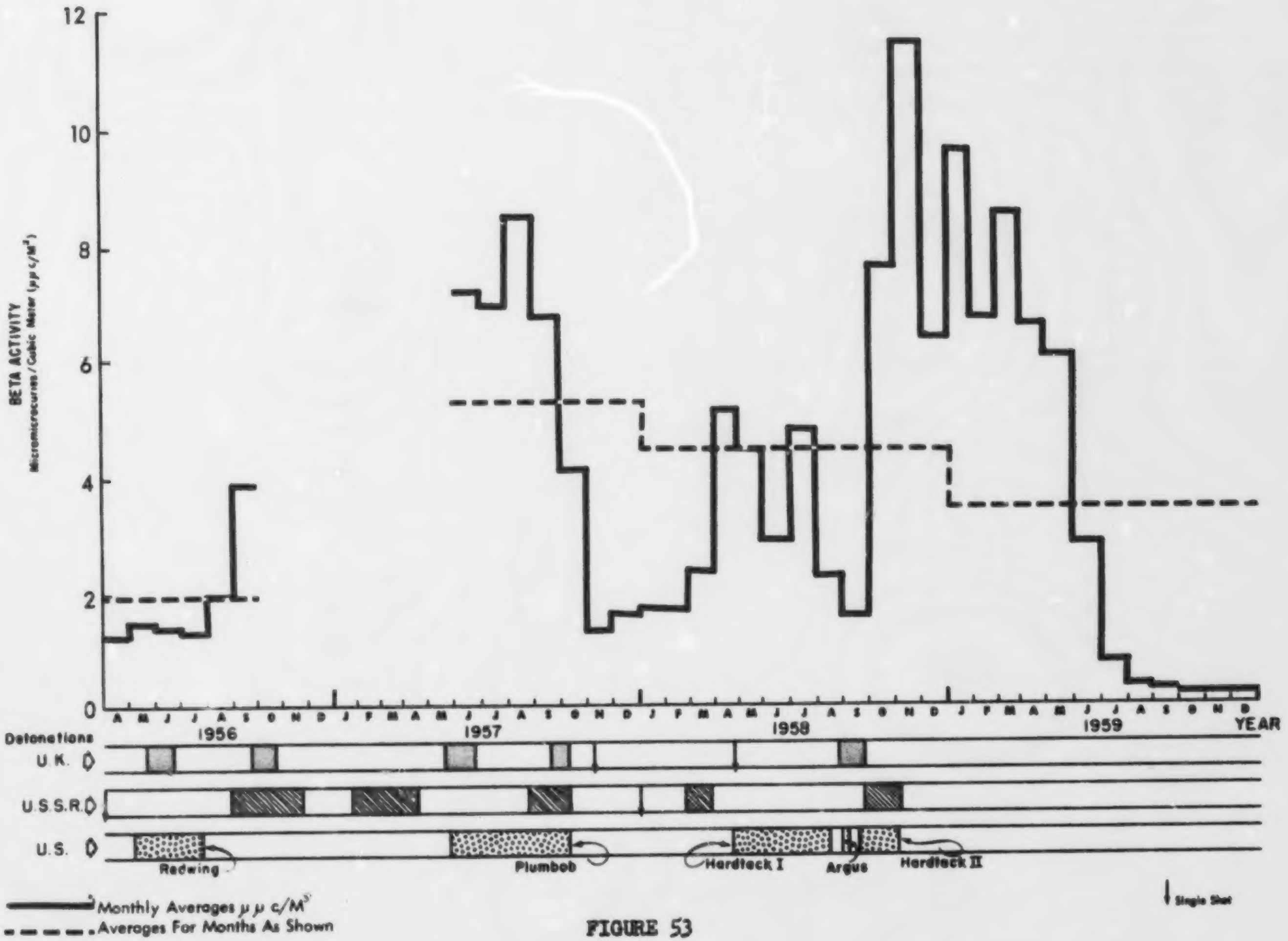


FIGURE 53

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Cincinnati, Ohio
Radiation Surveillance Network

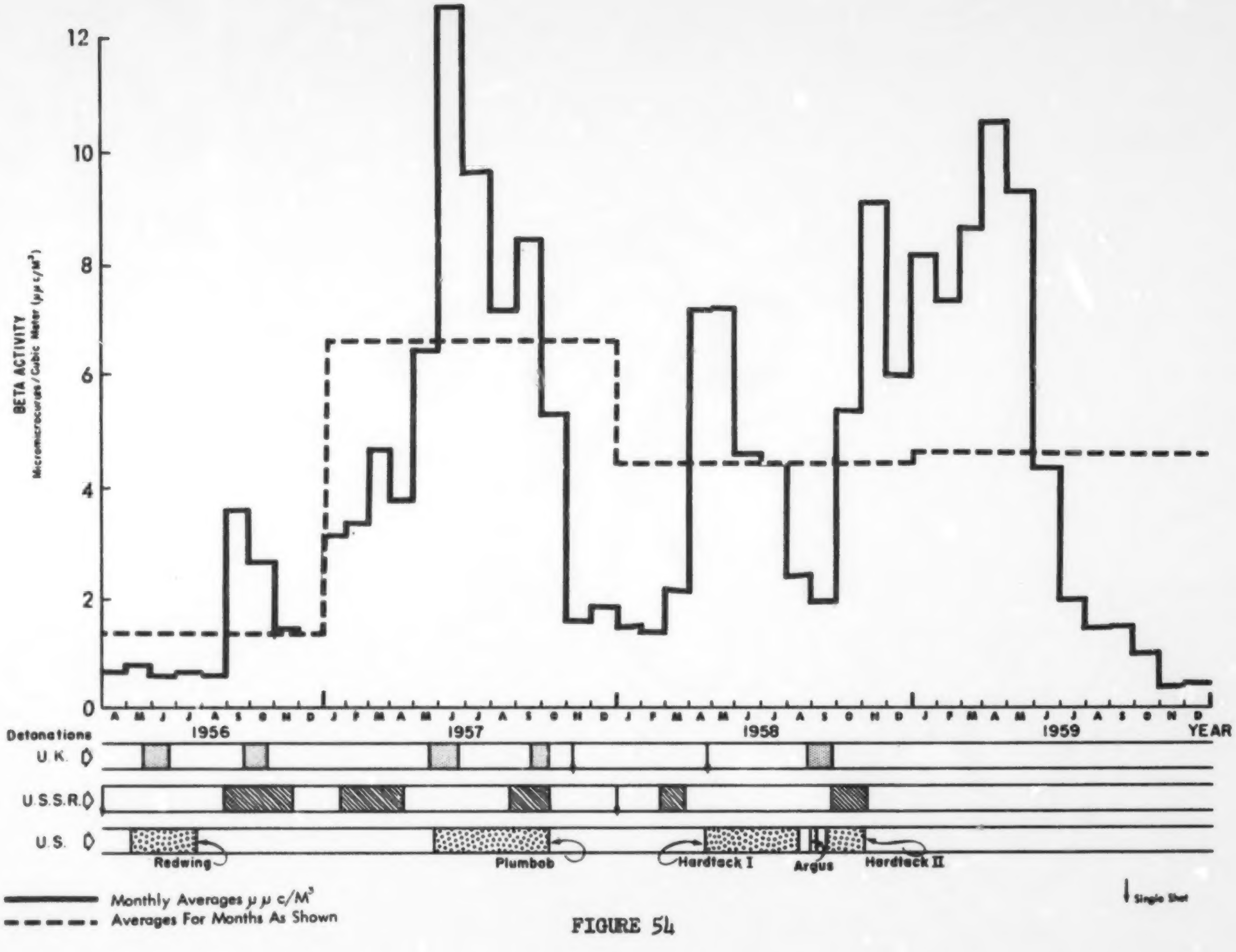


FIGURE 54

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Oklahoma City, Oklahoma
RADIATION SURVEILLANCE NETWORK

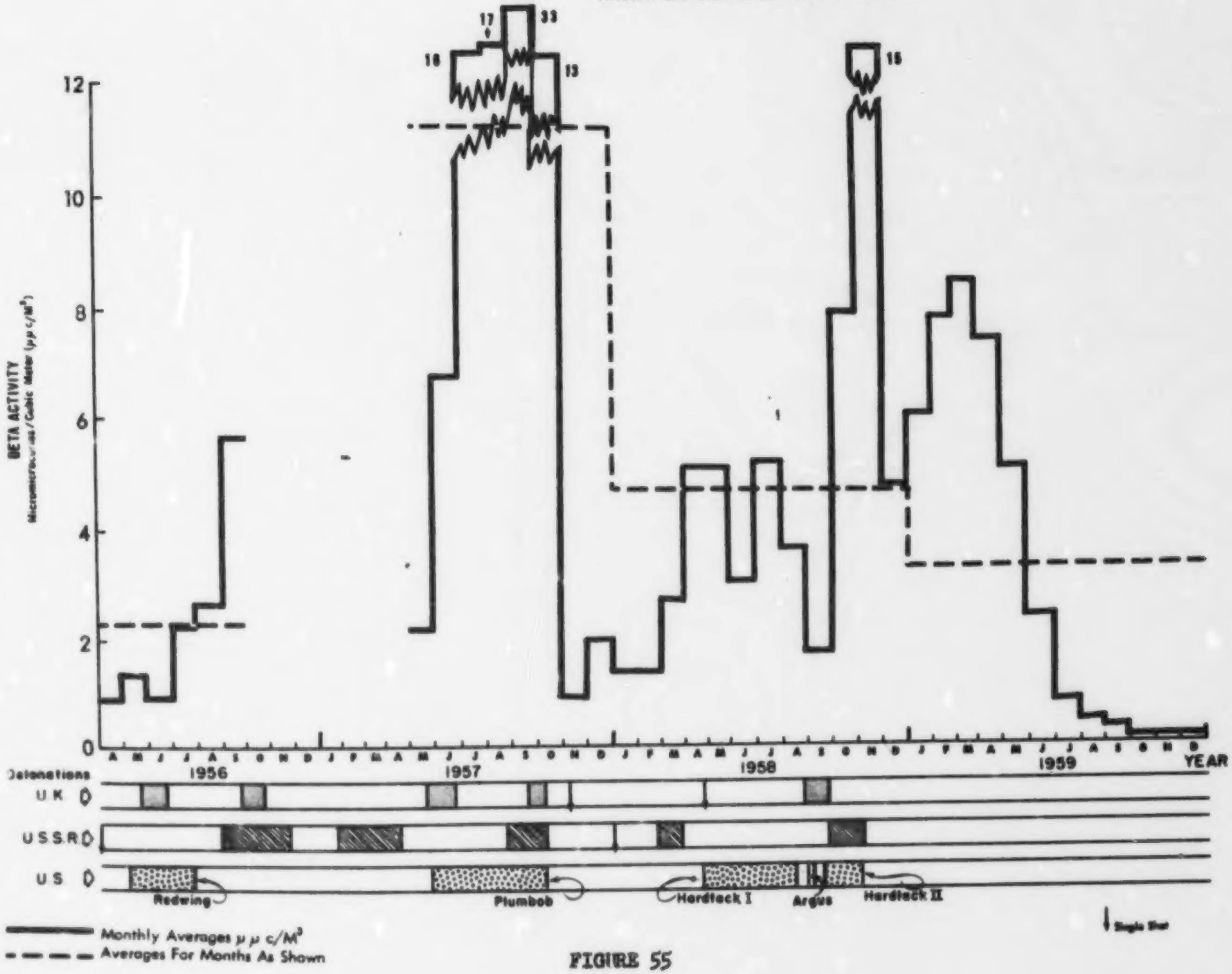


FIGURE 55

72<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Ponca City, Oklahoma
Radiation Surveillance Network

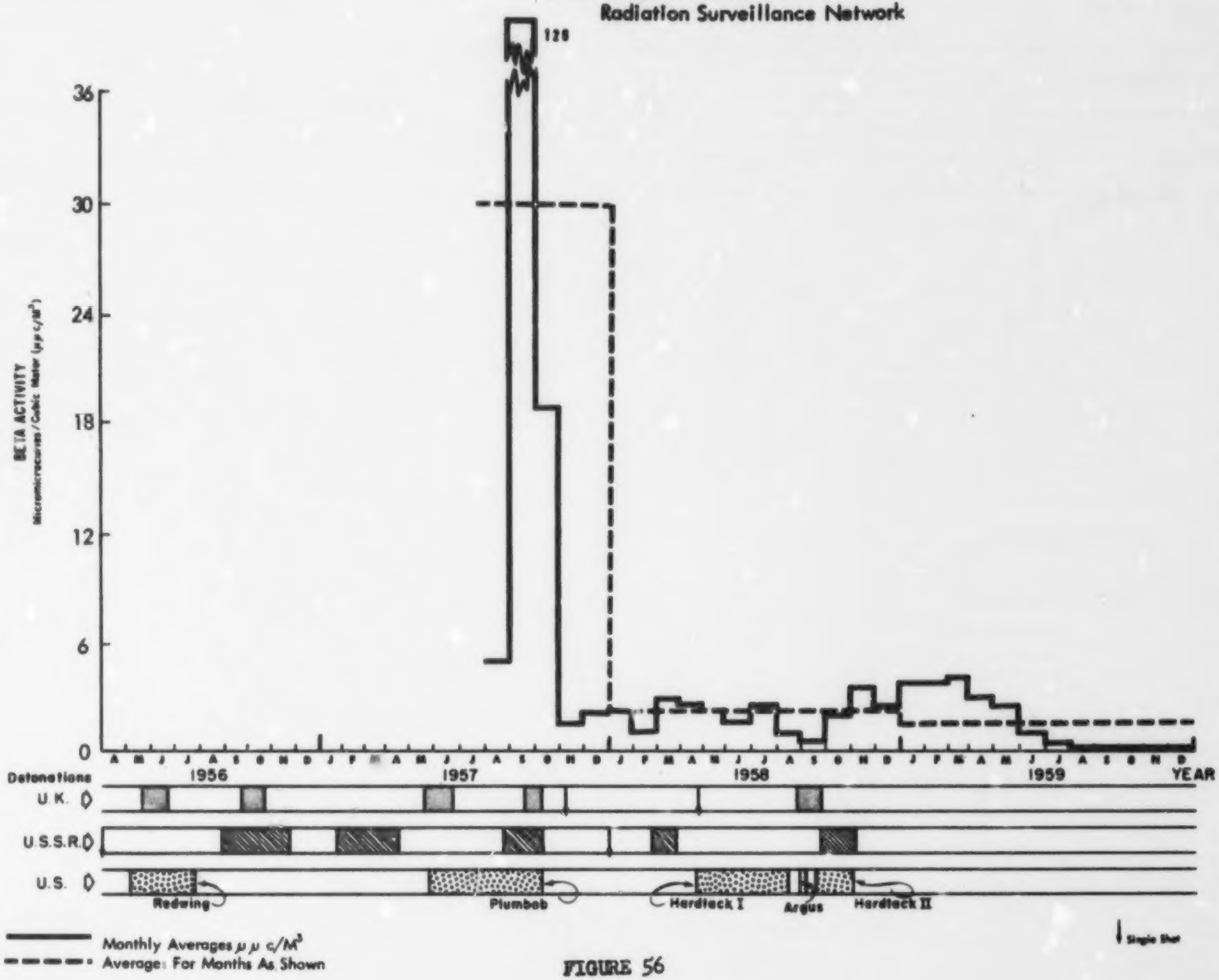


FIGURE 56

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Portland, Oregon
Radiation Surveillance Network

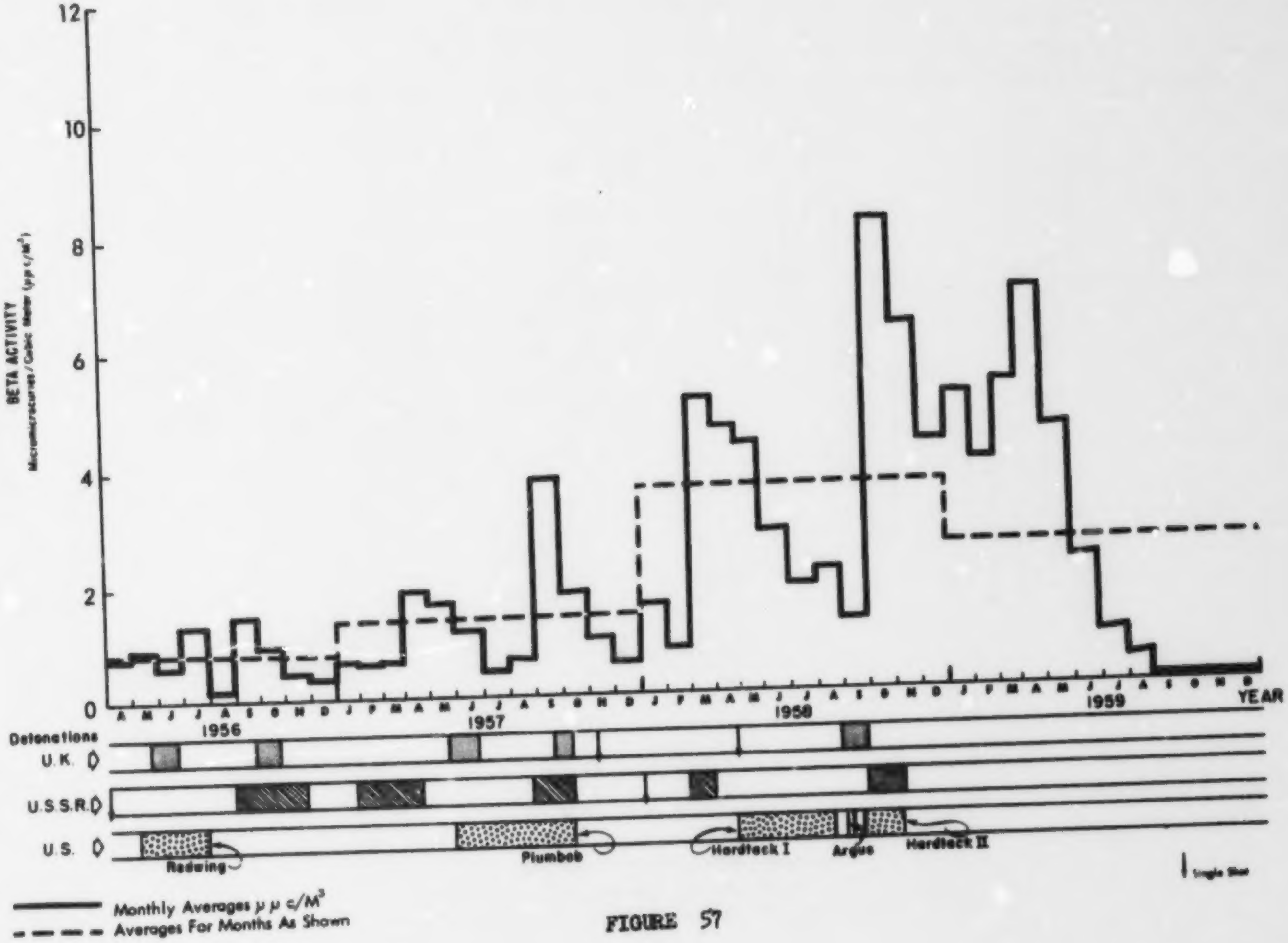


FIGURE 57

.75 <

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Harrisburg, Pennsylvania
Radiation Surveillance Network

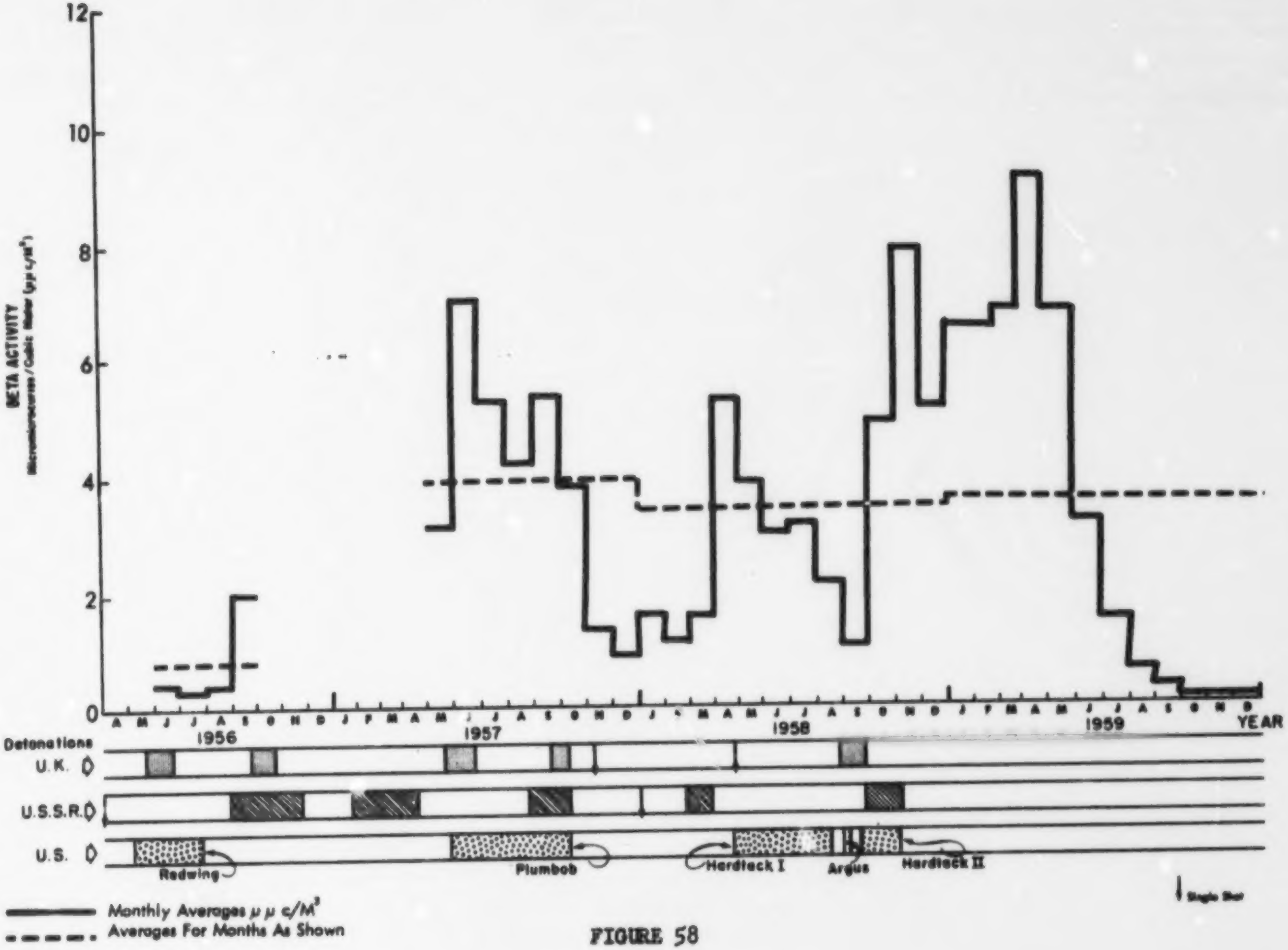


FIGURE 58

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Providence, Rhode Island
Radiation Surveillance Network

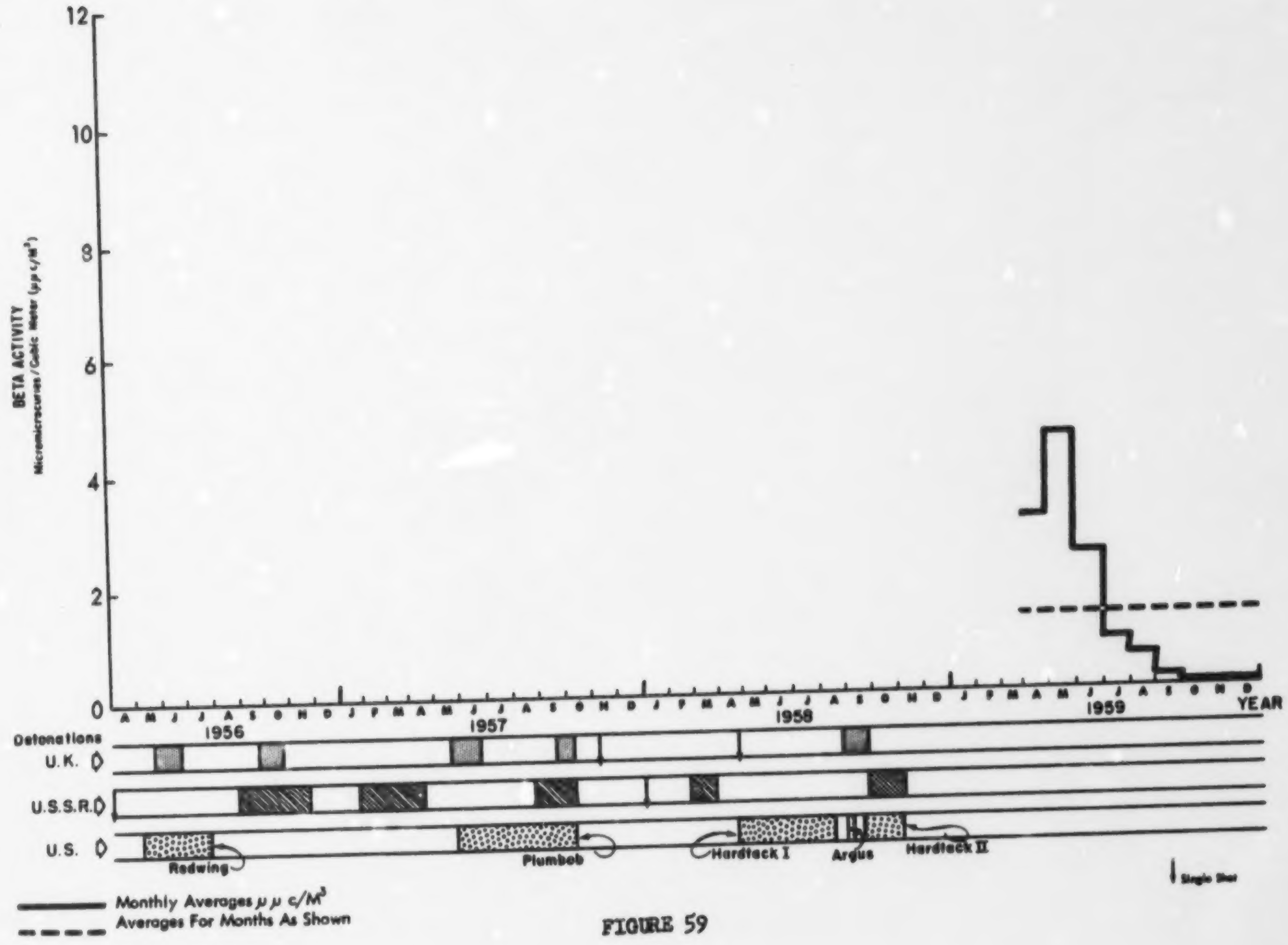


FIGURE 59

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Columbia, South Carolina
Radiation Surveillance Network

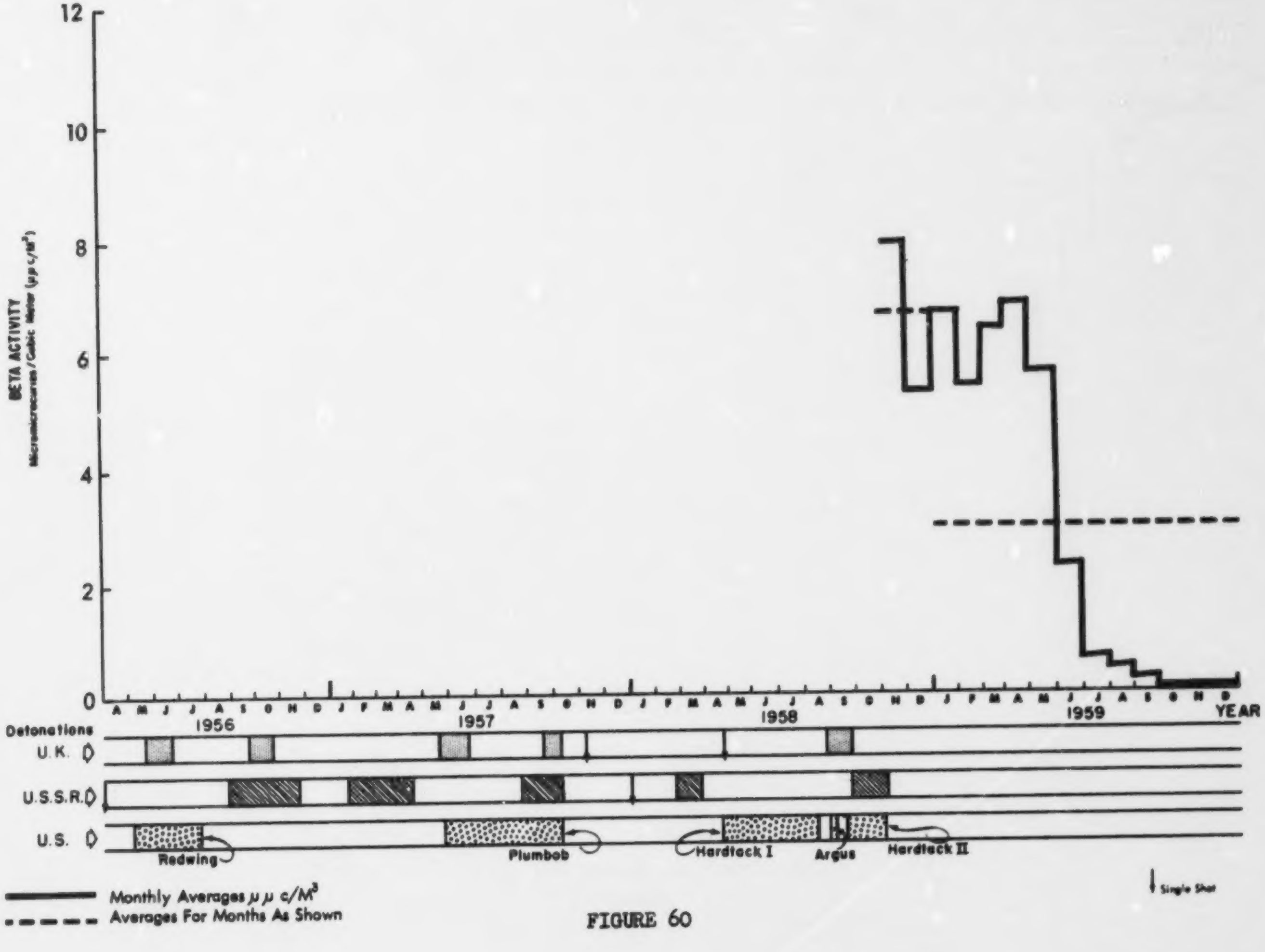


FIGURE 60

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Pierre, South Dakota
Radiation Surveillance Network

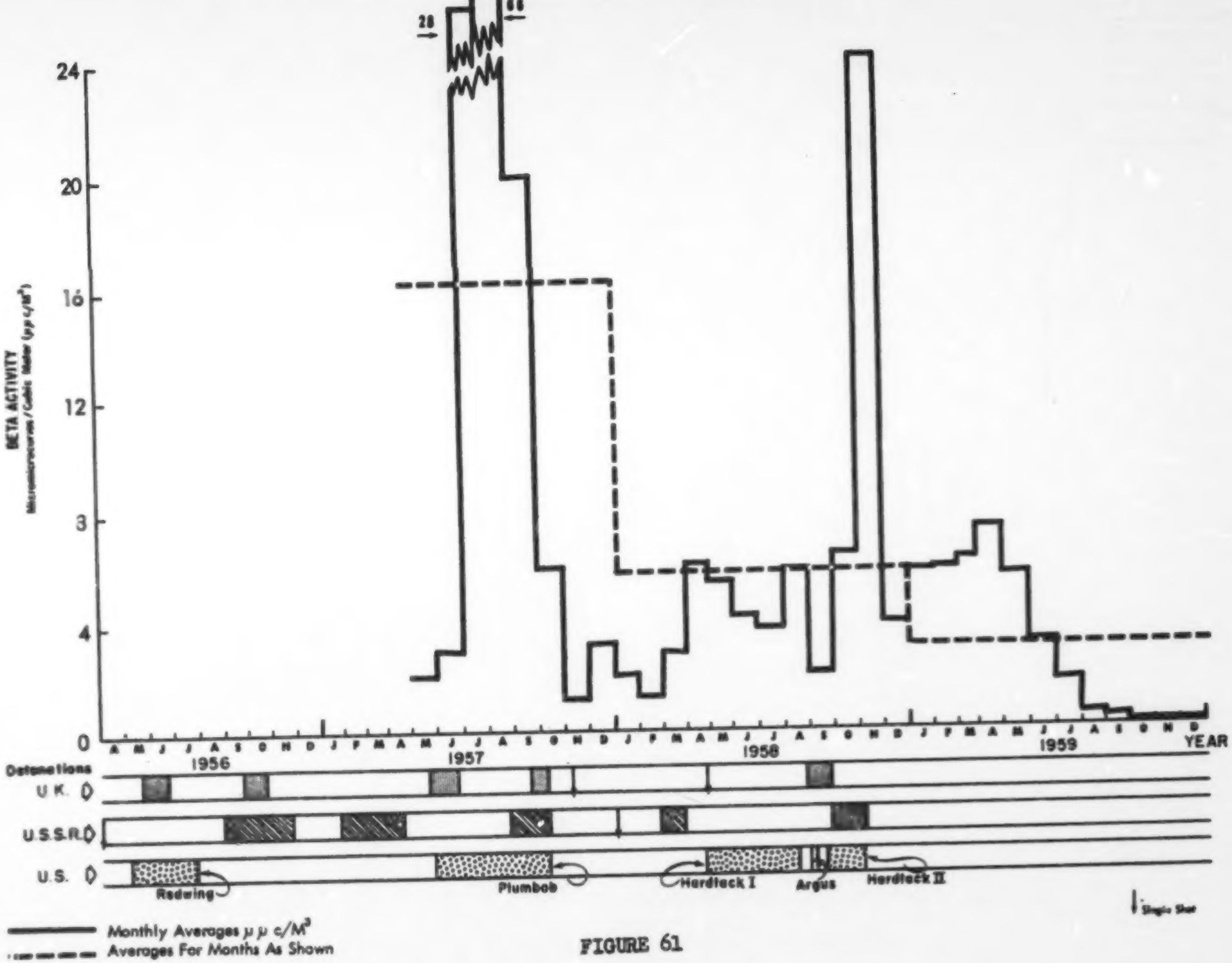
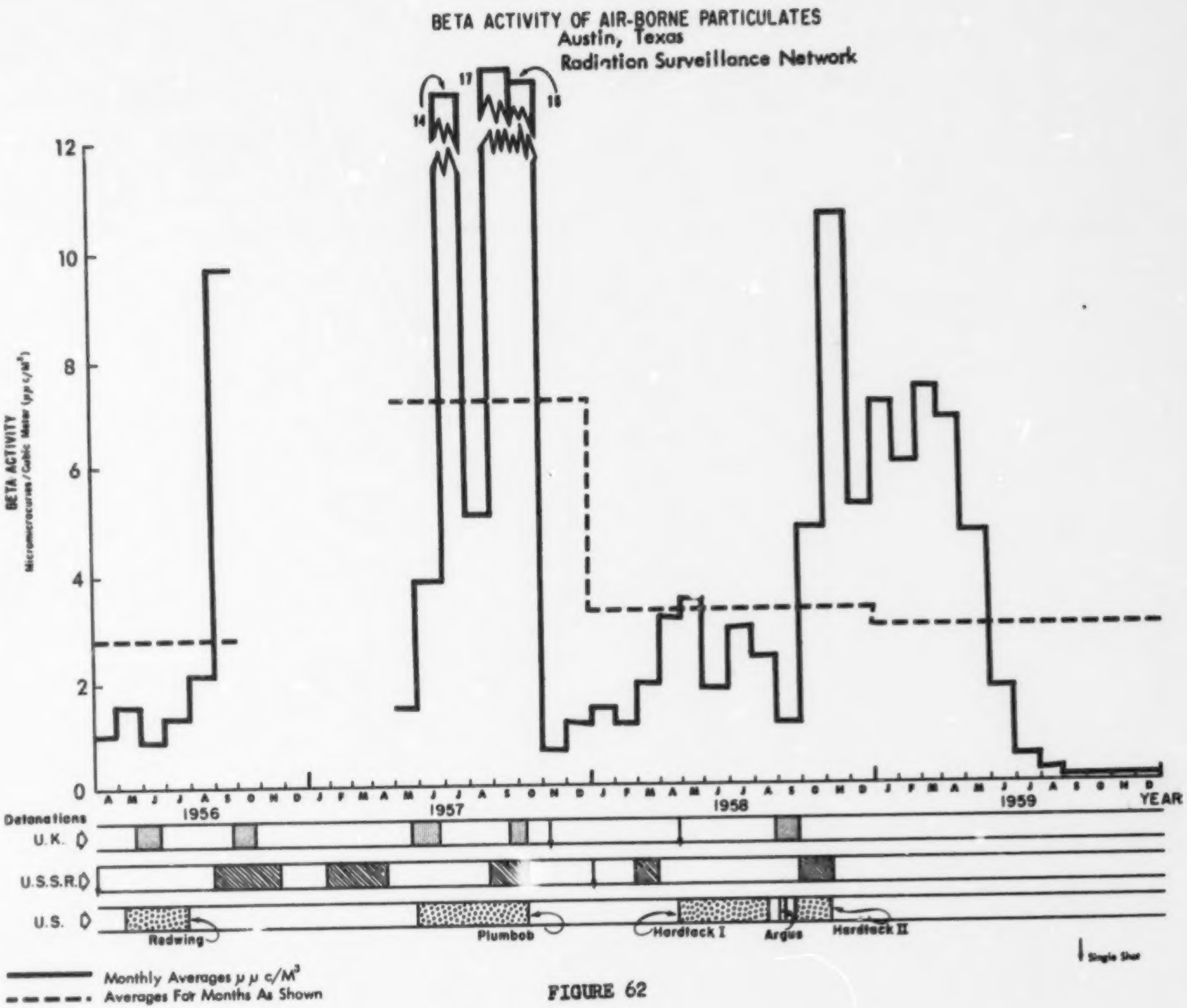


FIGURE 61

78<



BETA ACTIVITY OF AIR-BORNE PARTICULATES
Austin, Texas
Radiation Surveillance Network

FIGURE 62

BETA ACTIVITY OF AIR-BORNE PARTICULATES
El Paso, Texas
Radiation Surveillance Network

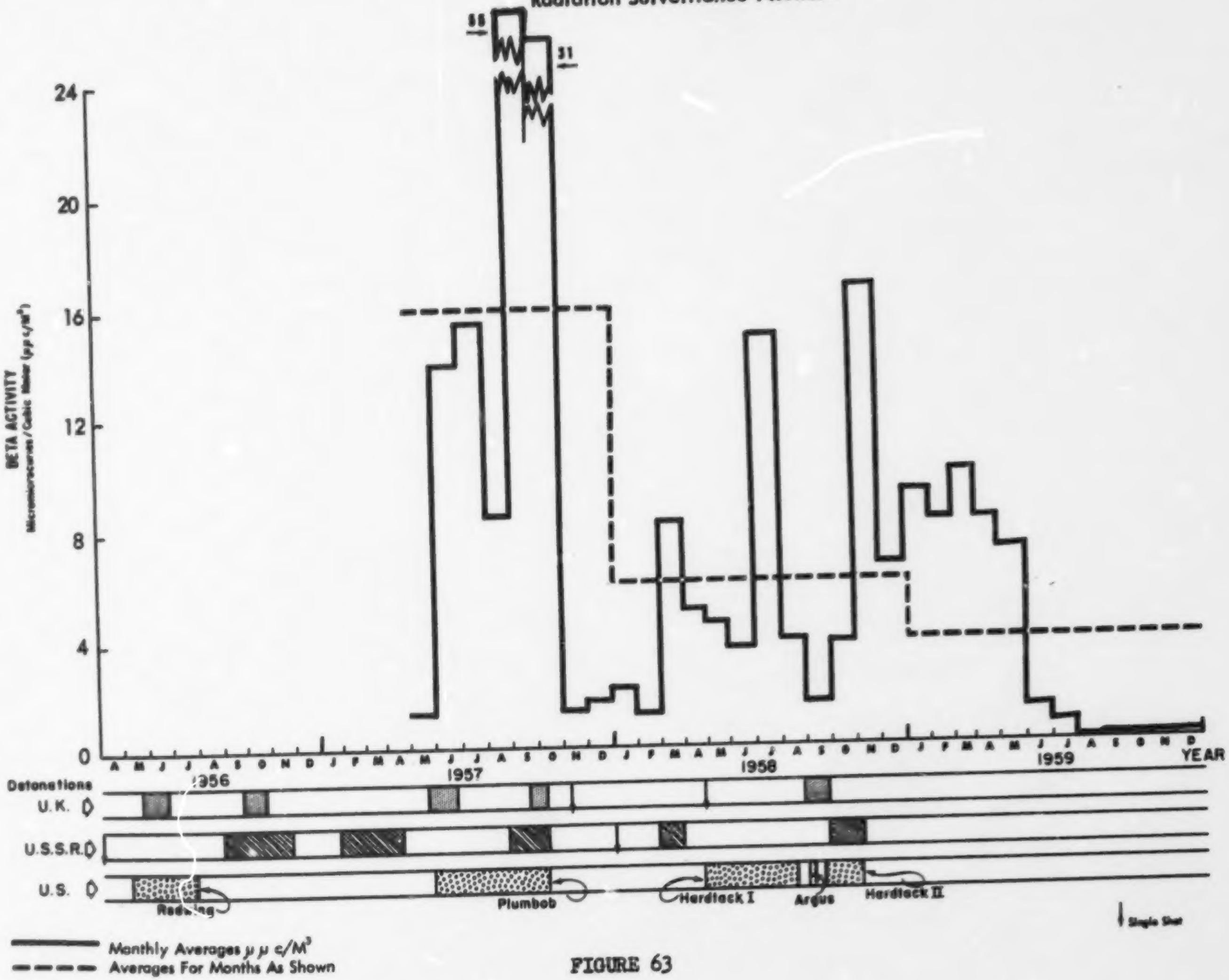


FIGURE 63

80<

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Salt Lake City, Utah
RADIATION SURVEILLANCE NETWORK

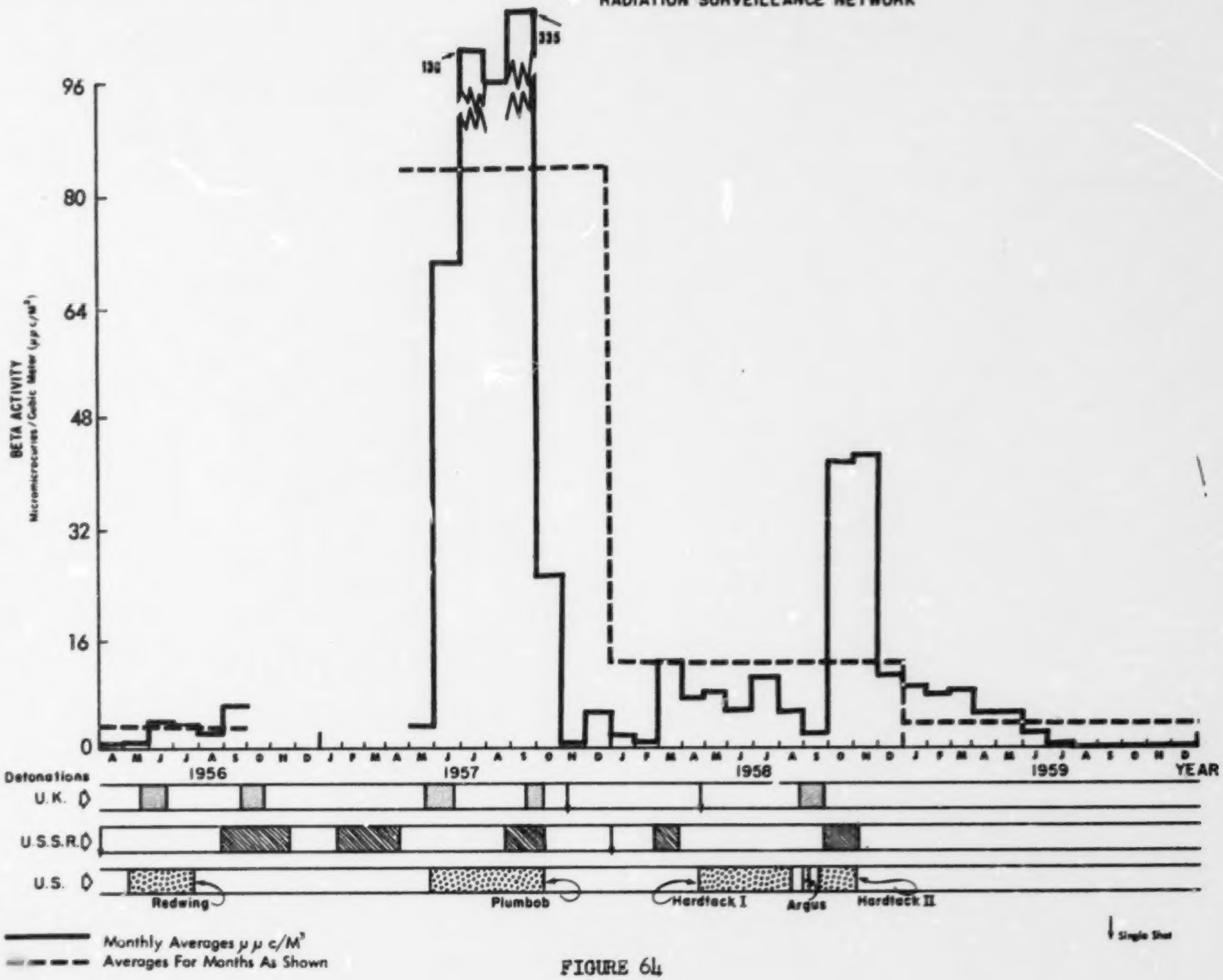


FIGURE 64

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Richmond, Virginia
Radiation Surveillance Network

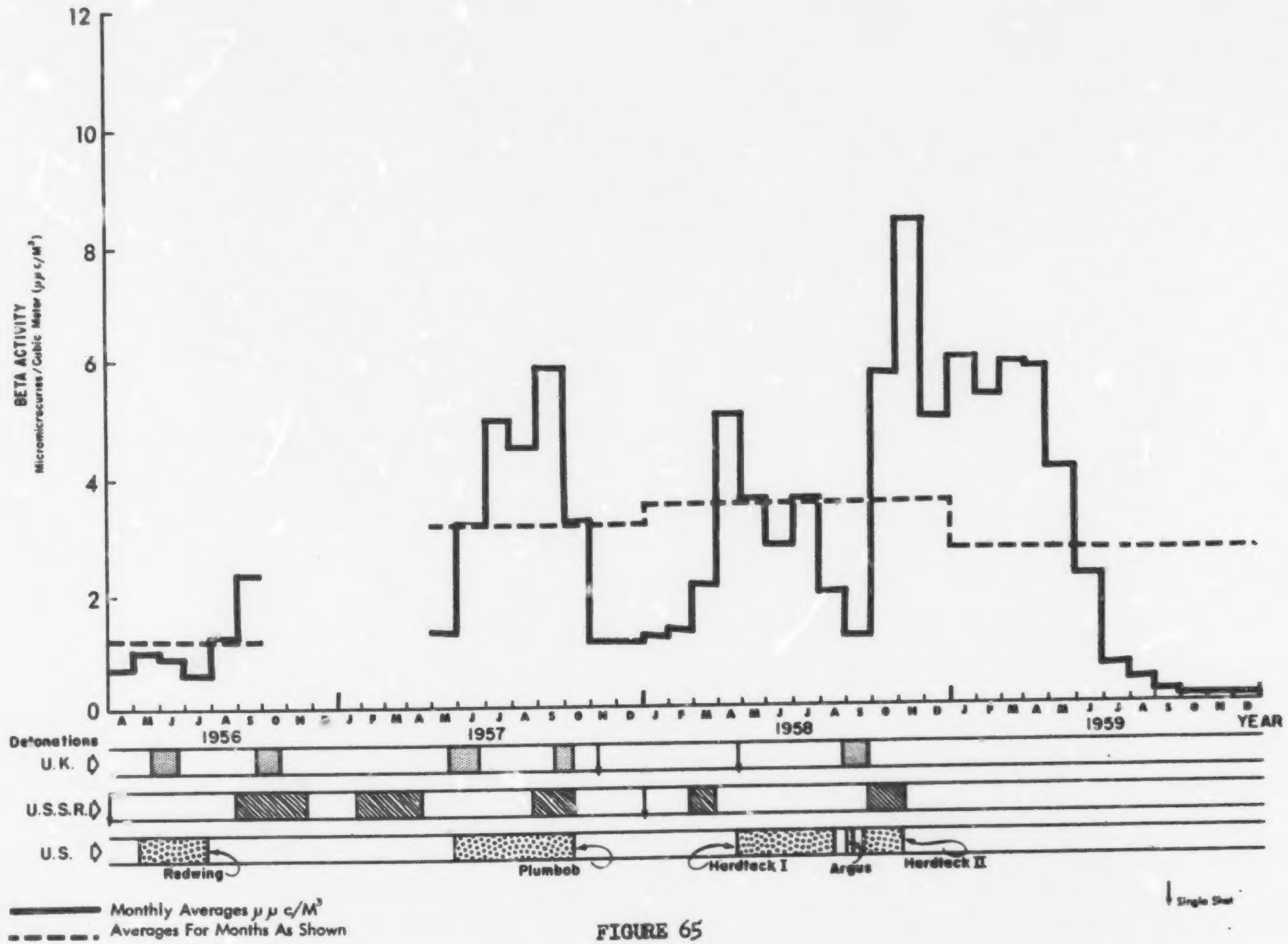


FIGURE 65

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Seattle, Washington
Radiation Surveillance Network

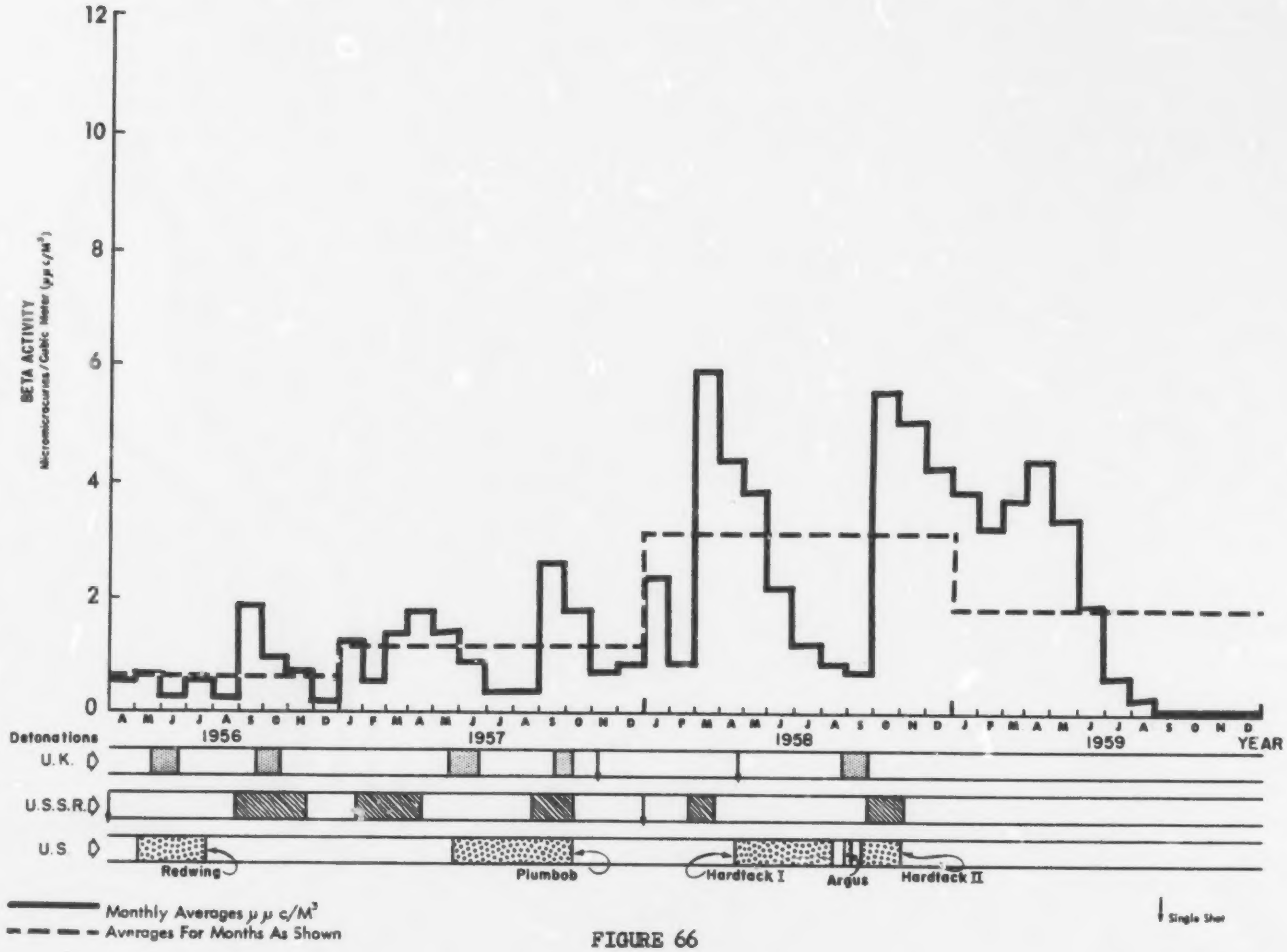


FIGURE 66

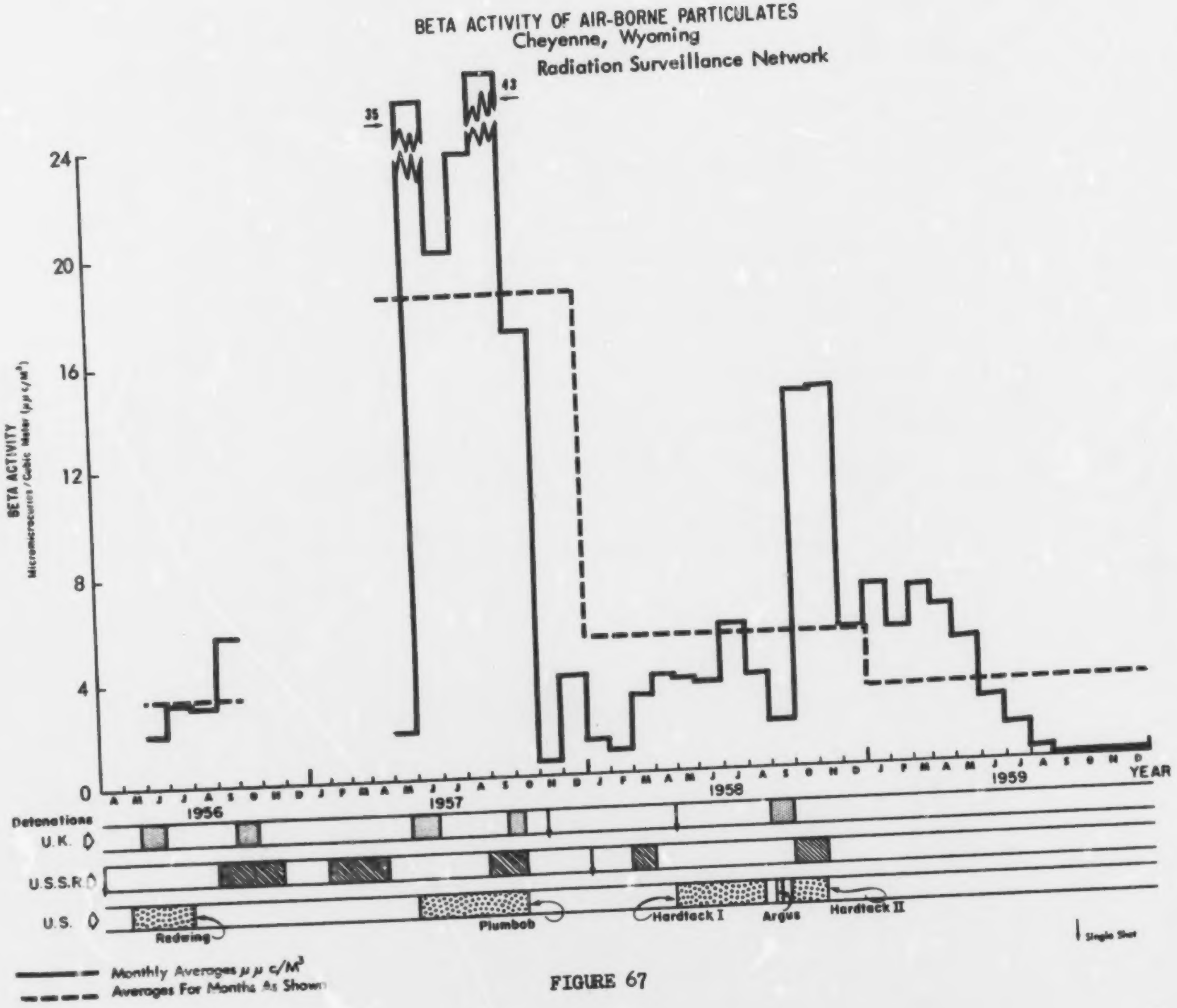

BETA ACTIVITY OF AIR-BORNE PARTICULATES
Cheyenne, Wyoming
Radiation Surveillance Network

FIGURE 67

TABLE VII.—RADON AND THORON AIR MEASUREMENTS

February 2, 1960 through February 29, 1960
Cincinnati, Ohio

RADIATION SURVEILLANCE NETWORK

(Beta Activity Included)

Date	Continuous Sample Collection			Beta (a) activity $\mu\mu c/M^3$	Radon (b) AM $\mu\mu c/M^3$	Radon (c) PM $\mu\mu c/M^3$	Thoron (d) $\mu\mu c/M^3$
	Sample change time	Sampling period (hours)	Volume M^3				
Feb. 2	0804	22.9	30.1	0.7	115	71	1.8
3	0808	23.9	30.7	0.4	161	110	1.1
4	0804	23.9	30.7	0.6	221	141	1.6
5	0808	23.9	30.8	0.2 (3)	153	89	1.9
8	0802	71.8	92.6	0.2	142	129	1.3
9	0804	24.0	31.5	0.5	226	173	1.6
10	0804	24.0	31.4	0.5	54	39	0.9
11	0806	24.0	30.1	0.2	76	48	0.3
12	0808	24.0	31.8	0.5 (3)	51	55	0.6
15	0808	72.0	91.2	0.2	345	46	0.8
16	0806	23.9	30.5	0.3	171	199	0.7
17	0806	23.9	31.0	0.3	101	85	0.6
18	0818	24.1	30.5	0.4	160	120	1.0
19	0804	23.7	31.1	0.09 (4)	129	55	0.5
23	0806	95.9	120.3	0.4	413	132	1.7
24	0806	23.9	30.0	0.4	192	125	0.9
25	0804	23.9	30.7	0.2	176	166	0.3
26	0806	23.9	29.5	0.09 (3)	63	53	0.2
29	0806	71.8	83.6	0.09	99	72	0.4
	Average...................................			0.3	160	100	0.95

(a) Gross beta activity when counted one day after end of sampling or later as indicated by numeral in parenthesis.

(b) Measured within a few minutes of removal of filter from sampler and corrected back to collection time (uncorrected for thoron daughter interference).

(c) Filters are temporarily withdrawn from sampler at about 3 p.m. and counted. (Values are corrected back to removal time.) The filters are then replaced on sampler to complete the sampling period of about 24 hours. Thus, the values in this column are from the same filters that are counted at about 8 a.m. the following day.

(d) Thoron from alpha activity of filter sample counted 7 hours after taking a 24-96 hour sample.

U. S. NAVAL RESEARCH LABORATORY

Data on Radioactivity in Air

Radioactivity measurements of air-filter samples collected at various sites along the 80th Meridian (West) are made by the U. S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during March 1960 is shown in Table VIII and the radioactivity profile for the same month is shown in Figure 68. All radioactivity concentrations are given in disintegrations per minute per cubic meter of air at the collecting site. (2.2 disintegrations per minute equals 1 micromicrocurie)

Increases in values recorded in February and March reflect the results of a nuclear detonation in the Sahara Desert February 13, 1960.

TABLE VIII.–U. S. NAVAL RESEARCH LABORATORY DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION

March 1960

	Disintegrations/minute per cubic meter of air						
Day	Punta Arenas	Puerto Montt	Santiago	Antofagasta	Chacaltaya	Lima	Guayaquil
1	0.05	0.17	0.14	0.12	0.09	0.03	0.32
2	0.05	0.17	0.14	0.12	0.09	0.03	1.10
3	0.05	0.15	0.13	0.11	0.08	0.06	1.22
4	0.05	0.15	0.13	0.11	0.08	0.06	1.56
5	0.02	0.10	0.14	0.09	0.07	0.01	1.56
6	0.02	0.10	0.14	0.09	0.07	0.01	1.52
7	0.02	0.10	0.06	0.09	0.07	0.01	1.52
8	-	0.13	0.06	0.09	0.05	0.08	1.08
9	-	0.13	0.06	0.09	0.05	0.08	0.85
10	-	0.05	0.12	0.09	0.05	0.05	0.46
11	-	0.05	0.12	0.09	0.05	0.05	0.41
12	-	0.07	0.12	0.14	0.06	0.08	0.39
13	-	0.07	0.12	0.14	0.06	0.08	0.24
14	-	0.07	0.12	0.14	0.06	0.08	0.24
15	-	0.09	0.14	0.13	0.08	0.05	-
16	-	0.09	0.14	0.13	0.08	0.05	-
17	-	0.12	0.14	0.14	0.06	-	-
18	-	0.12	0.14	0.14	0.06	-	-
19	-	0.07	0.12	0.12	0.06	-	-
20	-	0.07	0.12	0.12	0.06	-	-
21	-	0.07	0.12	0.12	0.06	-	-
22	-	0.07	0.18	0.13	0.05	-	0.14
23	-	0.12	0.18	0.13	0.05	-	0.16
24	-	0.09	0.18	0.13	0.04	-	0.20
25	-	0.09	0.18	0.13	0.04	-	0.18
26	-	-	0.09	0.13	0.02	-	0.14
27	-	-	0.09	0.13	0.02	-	0.14
28	-	-	0.09	0.13	0.02	-	0.14
29	-	-	0.12	0.11	0.04	-	-
30	-	-	0.12	0.11	0.04	-	-
31	-	-	0.20	0.13	0.01	-	-
Mean value	-	0.10	0.13	0.12	0.06	0.05	0.65

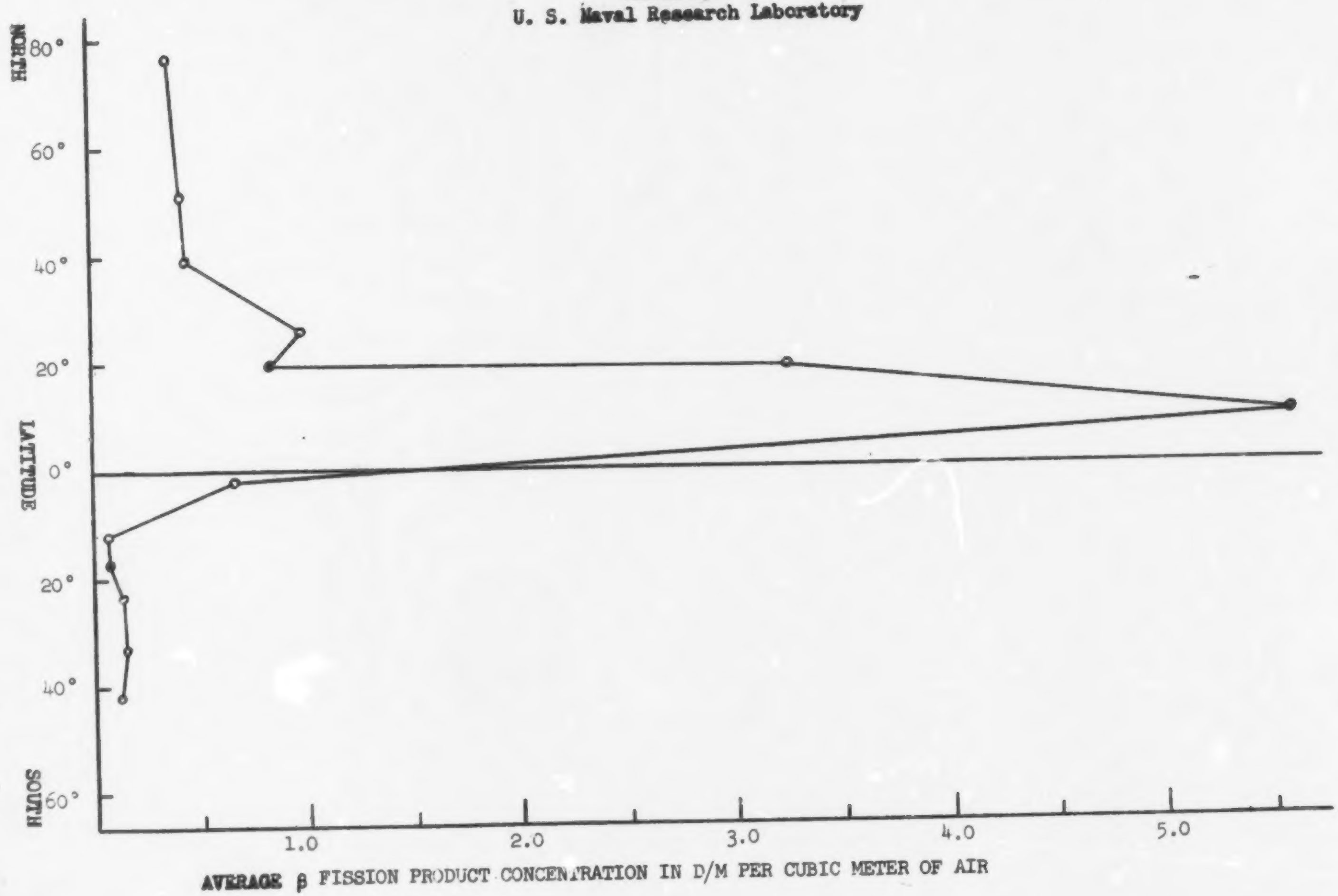
TABLE VIII.—U. S. NAVAL RESEARCH LABORATORY DAILY RECORD OF FISSION PRODUCT β—ACTIVITY COLLECTED BY AIR FILTRATION—Con.

March 1960

Day	Disintegrations/minute per cubic meter of air						
	Mira-flores	San Juan	Mauna Loa	Miami	Wash-ington	Moosonee	Thule
1	18.48	3.1	1.34	1.47	0.41	0.52	0.35
2	18.48	3.1	1.34	1.47	0.41	0.44	0.35
3	9.40	3.1	1.49	1.93	0.38	0.35	0.51
4	9.40	3.1	1.49	1.93	0.38	0.32	0.51
5	12.60	14.42	1.36	0.71	0.50	0.51	0.37
6	12.60	14.42	1.36	0.71	0.50	0.41	0.37
7	12.60	11.91	1.36	0.71	0.50	0.74	0.37
8	15.34	11.91	0.81	0.71	0.65	0.48	0.37
9	15.34	11.91	0.81	0.71	0.65	0.25	0.32
10	10.53	11.91	0.98	1.11	0.52	0.30	0.33
11	10.53	3.75	0.98	1.11	0.52	0.35	0.33
12	4.27	3.75	1.52	0.92	0.35	0.30	0.27
13	4.27	3.75	1.52	0.92	0.35	0.28	0.27
14	4.27	3.75	1.52	0.92	0.35	0.39	0.27
15	2.78	1.64	0.98	1.28	0.49	0.30	0.39
16	2.78	1.64	0.98	1.28	0.49	0.30	0.39
17	2.15	0.67	0.45	1.28	0.13	0.46	0.37
18	2.15	0.67	0.45	1.28	0.13	0.48	0.37
19	0.74	0.39	0.45	0.77	0.59	0.39	0.37
20	0.74	0.39	0.45	0.77	0.59	0.35	0.39
21	0.74	0.39	0.45	0.77	0.59	0.35	0.39
22	0.25	0.21	0.48	0.82	0.46	0.39	0.62
23	0.25	0.21	0.48	0.82	0.46	0.35	0.62
24	0.18	0.05	0.31	0.67	0.48	0.37	0.31
25	0.18	0.05	0.31	0.67	0.48	0.41	0.31
26	0.21	0.08	0.30	0.77	0.21	1.29	0.28
27	0.21	0.08	0.30	0.77	0.21	0.41	0.28
28	0.21	0.08	0.30	0.77	0.21	0.35	0.28
29	0.16	0.35	0.23	0.76	0.28	0.32	0.30
30	0.16	0.35	0.23	0.76	0.28	0.46	0.30
31	0.13	0.12	0.25	0.43	0.91	0.41	0.32
Mean value	5.55	3.23	0.82	0.97	0.43	0.42	0.36

FIGURE 68
Average Measurements of Surface Air at 14 Stations Along 80th Meridian

March 1960
U. S. Naval Research Laboratory



SECTION IV

WATER

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK

The National Water Quality Network was established under the provisions of Section 4(c) of Public Law 660, which states that ". . . the Surgeon General shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local health agencies, was started in October 1957. At present there are 61 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses; some of these stations are interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately a total of 250 to 300 stations will be operated. A few of the more recently established stations have not yet begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some continuous composite samples of 10 to 15 days are obtained. Radioactivity determinations are made on single samples, taken weekly.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The radioactivity levels of dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. The results are reported in micromicrocuries per liter, and are shown for each station on a given river.

While beta determinations for the first two years of the Network operation have been done on each sample weekly, the alpha determinations are reported generally on a composite sample of more than one week. Beginning with samples taken in January 1960, beta determinations are to be performed on composite samples obtained by combining two weekly samples. The alpha data will be reported on three-month composite samples, with one-third of the stations being covered each month. All the data reported below represent the average of all information available for the month indicated.

Strontium-90 data are reported as being the results of determinations on composite sample for a three-month period ending in the month shown.

Additional information and data may be obtained from the following sources:

1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.50.

2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, to Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, Pages 167-169.

FIGURE 69

PHS National Water Quality Network
SAMPLING STATIONS
1958-1959

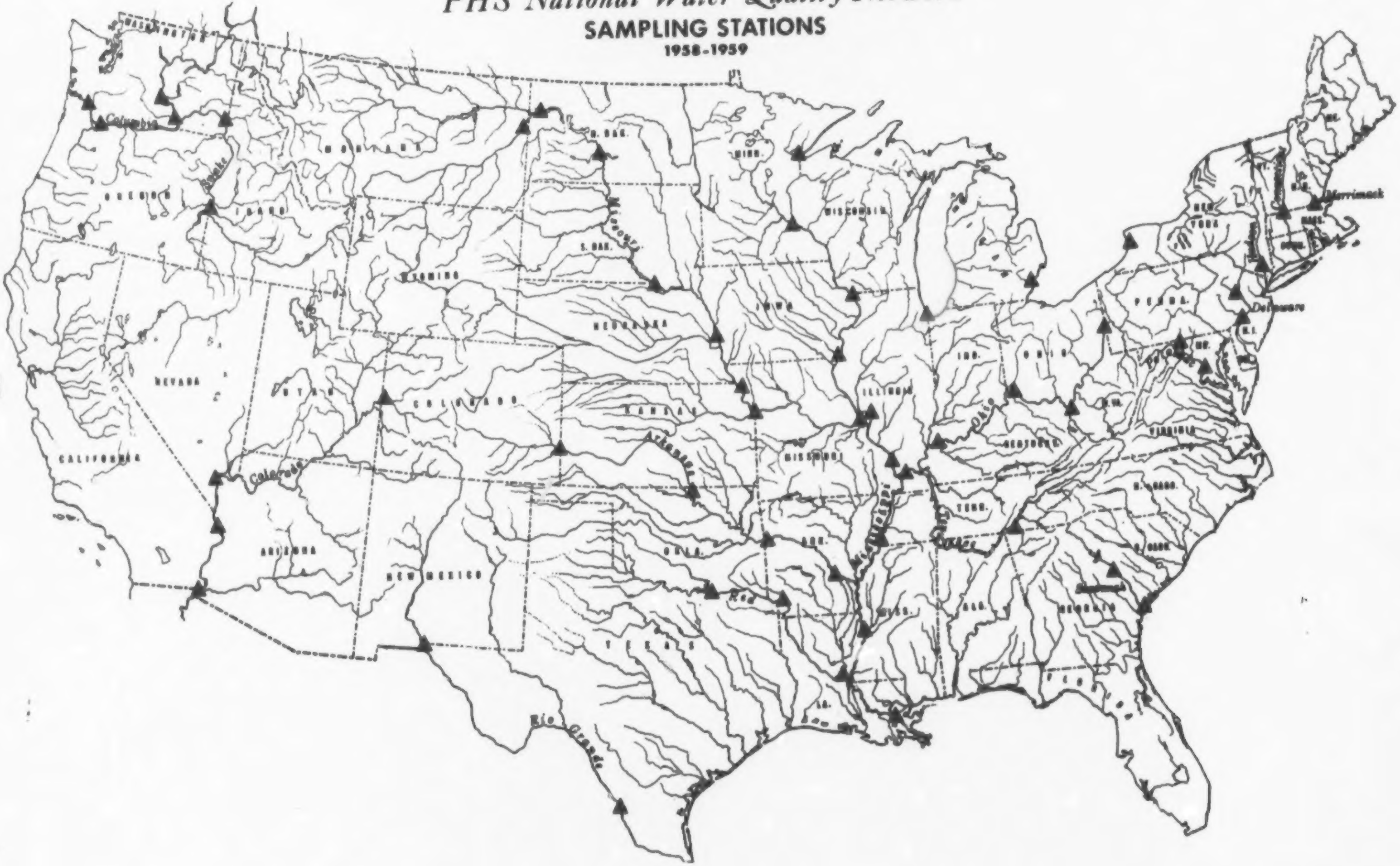

Columbia
Snake
MONTANA
OREGON
IDAHO
WYOMING
NEVADA
UTAH
COLORADO
CALIFORNIA
Colorado
ARIZONA
NEW MEXICO
N. DAK.
S. DAK.
Missouri
NEBRASKA
KANSAS
Arkansas
OKLA.
Red
TEXAS
Rio Grande
MINN.
WISCONSIN
IOWA
ILLINOIS
MISSOURI
ARK.
Mississippi
LA.
MISS.
IND.
OHIO
Ohio
KENTUCKY
TENN.
ALA.
GEORGIA
FLORIDA
S. CARO.
N. CARO.
VIRGINIA
W. VA.
PENNA.
NEW YORK
Delaware
Merrimack
ME.

TABLE IX.—U. S. PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK RADIOACTIVITY-IN RAW SURFACE WATERS

(Micromicrocuries per liter)

Station	Quarter ending 12/31/59	Month of January 1960 (Average to nearest whole number)					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Dis.	Tot.	Susp.	Dis.	Tot.
ALSEA RIVER							
Alsea, Oreg.	0.2	0	0	0	0	0	0
ARKANSAS RIVER							
Coolidge, Kans.	0.4	3	5	8	-	-	-
Ponca City, Okla.	0.6	8	16	24	0	8	8
Fort Smith, Ark.	1.2	-	-	-	-	-	-
Pendleton Ferry, Ark.	0.6	54	6	60	5	1	6
CHATTAHOOCHIE RIVER							
Columbus, Ga.	0.2	2	2	4	0	0	0
COLORADO RIVER							
Loma, Colo.	0.3	15	40	55	2	4	6
Page, Ariz.	0.3	34	0	34	8	18	26
Hoover Dam, Ariz.-Nev.	0.7	0	4	4	1	10	11
Parker Dam, Ariz.-Calif.	0.7	0	3	3	<1	5	5
Yuma, Ariz.	0.6	0	0	0	<1	9	10
COLUMBIA RIVER							
Wenatchee, Wash.	0.8	1	6	7	0	2	2
Pasco, Wash.	0.9	61	472	533	0	1	1
Bonneville Dam, Oreg.	1.0	37	374	411	0	1	1
Clatskanie, Oreg.	0.5	148	38	186	0	0	0
CONNECTICUT RIVER							
Northfield, Mass.	0.3	-	-	-	-	-	-
DELAWARE RIVER							
Martin's Creek, Pa.	-	5	7	12	0	<1	<1
Philadelphia, Pa.	0.6	3	0	3	0	0	0
GREAT LAKES							
Gary, Ind.	0.4	0	1	1	0	0	0
Duluth, Minn.	0.3	3	9	12	0	0	0
Detroit, Mich.	0.7	<1	7	7	1	0	1
Buffalo, N. Y.	1.1	3	2	5	0	1	1
HUDSON RIVER							
Poughkeepsie, N. Y.	1.3	11	21	32	-	-	-
MERRIMACK RIVER							
Lowell, Mass.	0.5	2	4	6	-	-	-
MISSISSIPPI RIVER							
Red Wing, Minn.	0.7	0	4	4	0	3	3
Dubuque, Iowa	1.4	3	13	16	-	-	-
Burlington, Iowa	1.0	7	3	10	3	1	4
East St. Louis, Ill.	0.5	10	3	13	5	1	6
Cape Girardeau, Mo.	0.4	20	6	26	5	2	7
West Memphis, Ark.	1.3	8	6	14	3	0	3
Delta, La.	1.0	-	-	-	-	-	-
New Orleans, La.	0.9	10	4	14	6	4	10

TABLE IX.--U. S. PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK RADIOACTIVITY-IN RAW SURFACE WATERS--Con.

(Micromicrocuries per liter)

Station	Quarter ending 12/31/59	Month of January 1960 (Average to nearest whole number)					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Dis.	Tot.	Susp.	Dis.	Tot.
MISSOURI RIVER							
Williston, N. D.	0.5	0	4	4	0	5	5
Bismarck, N. D.	0.9	1	11	12	0	5	5
Yankton, S. D.	0.5	<1	2	3	1	6	7
Omaha, Nebr.	1.0	0	8	8	0	4	4
St. Joseph, Mo.	0.4	5	10	15	6	7	13
Kansas City, Kans.	0.7	24	13	37	6	4	10
St. Louis, Mo.	0.6	28	7	35	21	0	21
OHIO RIVER							
East Liverpool, Ohio	0.6	0	0	0	0	0	0
Huntington, W. Va.	0.2	7	1	8	1	2	3
Cincinnati, Ohio	0.8	1	<1	1	5	1	6
Evansville, Ind.	-	5	3	8	2	1	3
Cairo, Ill.	1.2	7	1	8	1	2	3
POTOMAC RIVER							
Williamsport, Md.	0.5	1	1	2	0	1	1
Great Falls, Md.	0.4	<1	0	<1	0	1	1
RED RIVER							
Denison, Tex.	1.9	0	4	4	0	0	0
Index, Ark.	0.9	3	3	6	1	3	4
Alexandria, La.	1.6	28	8	36	8	0	8
RIO GRANDE RIVER							
Laredo, Tex.	0.7	0	5	5	1	4	5
Brownville, Tex.	0.3	0	4	4	3	1	4
ST. MARY'S RIVER							
Sault Ste. Marie, Mich.	0.3	<1	0	<1	0	0	0
SAVANNAH RIVER							
North Augusta, S. C.	0.7	5	3	8	-	-	-
Port Wentworth, Ga.	0.7	2	8	10	0	0	0
SNAKE RIVER							
Wawawai, Wash.	0.4	0	10	10	0	3	3
TENNESSEE RIVER							
Chattanooga, Tenn.	1.1	15	32	47	-	-	-
YELLOWSTONE RIVER							
Sidney, Mont.	0.7	0	6	6	0	3	3

TABLE X.--HEALTH AND SAFETY LABORATORY--ATOMIC ENERGY COMMISSION

Strontium-90 in New York City Tap Water

(Micromicrocuries per liter of water)

Month 1959	Strontium-90	Sr-89/Sr-90 at midpoint of sampling month
December	0.63	0.7

TABLE XI.--STRONTIUM-90 DETERMINATIONS ON CISTERN WATER COMPOSITES

Monthly samples of several roof-collected U. S. Coast Guard rain water cistern supplies are routinely analyzed for beta activity by the Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio. Some samples are composited each three months and further analyzed for strontium-90 activity. Additional data concerning this investigation appears in "Statement on New Data on Uptake In Milk, Food and Human Bone," by C. P. Straub, submitted to Joint Committee Hearings on Fallout from Nuclear Weapons, May 1959, Vol. II, Page 990.

Measurements for gross beta activity of monthly cistern water samples and other references appear in Radiological Health Data, June 1960 Monthly Report, Volume I, No. 3.

Strontium-90 Analyses on Cistern Water Composites

Location	Period collected	Strontium-90 $\mu\mu c/l$*
	(1959)	
Metomkin, Accoma, Va.	Oct., Dec.	3.5
Port O'Connor, Tex.	Oct., Nov., Dec.	1.7
Grand Isle, La.	Oct., Nov., Dec.	2.0
Cape Hatteras, Buxton, N. C.	Oct., Dec.	1.6
Patos Island, Bellingham, Wash.	Oct., Nov., Dec.	1.0
Cape Flattery, Neah Bay, Wash.	Oct., Nov.	3.3
Cobb Island, Oyster, Va.	Oct., Nov.	2.9
Moose Peak, West Jones Port, Maine	Oct., Dec.	1.7
Swansboro, N. C.	Oct., Dec.	2.9
Cuckolds, Newagen, Maine	Oct., Dec.	1.6
Hamilton County, Ohio	November	3.6
Hamilton County, Ohio	Oct., Nov., Dec.	2.7

*Average error ± 0.1.

SECTION V

OTHER DATA

STRONTIUM-90 ACTIVITY IN HUMAN BONE

From St. Louis, Missouri Area—Public Health Service

The first set of data from a continuing program of collection and radiochemical analyses of human bones from St. Louis and its environs is tabulated in Tables XII and XIII below. For comparative purposes, Table XIV shows the strontium-90 activity in children's bones for North America as reported by the Geochemical Laboratory, Lamont Geological Observatory, Columbia University.

Although the strontium-90 values for the "Fetus" age group for the St. Louis data are somewhat higher than for "North America," and the reverse is true for the "0-1 year" age group, the number of speciments to date is too small to permit firm conclusions.

TABLE XII.--STRONTIUM-90 ANALYSES--HUMAN BONE SAMPLES

Age	Sex	Type of bone	Quarter and year of death		Bones (Grams)			Strontium-90 ($\mu\mu c$/Gram)		
					Dry	Ash	Ca0	Bone	Ash	Ca
Fetal and stillborn:										
Stillborn	F	Vertebra	3	1959	17.1	4.9	(*)	(*)	**0.49	**1.35
6 month fetal		Vertebra	3	1959	8.0	2.2	1.25	0.17	0.59	1.48
Stillborn	M	Femur, lumbar/ vertebra	3	1959	27.6	6.7	3.37	0.07	0.30	0.77
Stillborn	M	Lumbar vertebra	4	1959	17.4	6.1	(*)	(*)	**0.47	**1.30
Stillborn	M	Lumbar vertebra/ribs	3	1959	27.1	8.0	4.25	0.15	0.50	1.32
Stillborn	M	Vertebra	4	1959	29.1	9.0	4.70	0.14	0.44	1.16
Stillborn	M	Vertebra	4	1959	12.8	3.0	1.59	0.07	0.30	0.81
Stillborn	M	Vertebra	4	1959	7.4	2.5	1.33	0.16	0.49	1.37
Newborn (Up to age 1 year):										
8 weeks	(*)	Lumbar vertebra	4	1959	21.1	5.0	2.66	0.18	0.76	2.0
6 weeks	F	Lumbar vertebra	4	1959	7.7	2.4	1.28	0.17	0.54	1.42
17 hours	M	Vertebra	4	1959	21.3	3.7	1.95	0.05	0.26	0.70
1 month	F	Rib, sternum,/ vertebra	4	1959	6.2	1.7	0.95	0.29	1.05	2.81
4 months	M	Vertebra	1	1960	16.0	3.2	1.70	0.23	1.15	3.04
Children (Age 1-10 years):										
9 years	F	Vertebra column	3	1959	39.3	9.6	5.03	0.02	0.08	0.21
17 months	M	Skull, vertebra	3	1959	15.1	7.5	3.97	0.06	0.13	0.36
9 years	M	Vertebra	4	1959	6.2	1.6	0.85	0.31	1.23	3.3
4 years	M	Vertebra	4	1959	42.8	8.6	(*)	(*)	**0.69	**1.90
9 years	M	Vertebra	4	1959	50.7	7.6	(*)	(*)	**0.40	**1.08
14 months	M	(*)	4	1959	29.5	5.9	3.14	0.19	0.98	2.58
5 years	M	Vertebra	1	1960	28.8	5.7	3.02	0.11	0.57	1.53
1-1/2 years	M	Vertebra	1	1960	18.6	4.1	2.18	0.06	0.28	0.74
10 years	F	Vertebra	1	1960	76.0	10.6	5.63	0.04	0.26	0.68
6 years	M	Vertebra	1	1960	43.9	9.2	4.89	0.14	0.65	1.74
3 years	M	Vertebra	(*)	(*)	25.9	4.2	2.24	0.17	1.04	2.78
Children (Age 11-20 years):										
11 years	F	Rib, vertebra	3	1959	23.7	6.7	3.52	0.08	0.30	0.79
15 years	F	Vertebra column	3	1959	26.7	7.6	3.99	0.01	0.04	0.09
12 years	M	Lumbar vertebra	3	1959	116.5	32.7	17.40	0.09	0.31	0.81
15 years	M	Lumbar vertebra	4	1959	154.8	16.8	8.9	0.05	0.45	1.19
13 years	F	Vertebra	1	1960	59.1	10.1	5.35	0.11	0.67	1.79

* Undetermined. **Radiochemical analyses performed by the Health and Safety Laboratory, A.E.C.

TABLE XII.--STRONTIUM-90 ANALYSES--HUMAN BONE SAMPLES--Con.

Age	Sex	Type of Bone	Quarter and year of death	Bones (Grams)			Strontium-90 ($\mu\mu c$/Gram)		
				Dry	Ash	Ca0	Bone	Ash	Ca
Adults (Age 21 or older):									
33 years	F	Rib, vertebra	3 1959	45.1	16.4	9.07	0.05	0.14	0.36
54 years	M	Rib, vertebra	3 1959	36.7	11.0	6.01	0.05	0.18	0.47
71 years	M	Vertebra	3 1959	131.3	32.2	18.00	0.05	0.20	0.48
57 years	F	Vertebra	3 1959	47.1	10.4	5.82	0.05	0.23	0.63
68 years	F	Vertebra	3 1959	102.8	12.7	7.12	0.02	0.19	0.47
37 years	M	Rib, vertebra	3 1959	46.6	16.8	9.35	0.00	0.002	0.005
80 years	F	Lumbar vertebra	3 1959	33.1	8.3	4.47	0.09	0.25	0.63
72 years	M	Lumbar vertebra	3 1959	53.4	8.4	4.57	0.03	0.18	0.46
47 years	M	Lumbar vertebra	3 1959	98.8	20.6	10.80	0.05	0.26	0.75
44 years	M	Lumbar vertebra	3 1959	50.4	9.2	4.82	0.03	0.19	0.50
49 years	F	Vertebra	3 1959	39.5	10.8	5.67	0.01	0.05	0.13
48 years	M	Rib, vertebra	2 1959	183.7	41.5	21.70	0.01	0.06	0.17
69 years	M	Lumbar vertebra	3 1959	58.3	14.0	7.5	0.04	0.15	0.40
87 years	M	Lumbar vertebra	3 1959	92.0	23.2	12.35	0.07	0.28	0.74
61 years	M	Lumbar vertebra	3 1959	74.0	13.8	7.40	0.03	0.16	0.43
47 years	M	Lumbar vertebra	3 1959	52.5	12.6	6.7	0.09	0.37	0.99
75 years	M	Lumbar vertebra	3 1959	105.2	25.4	13.52	0.03	0.12	0.32
46 years	M	Lumbar vertebra	3 1959	49.4	14.1	7.5	0.03	0.11	0.30
48 years	M	Vertebra	3 1959	48.1	15.3	8.10	0.02	0.08	0.22
81 years	F	Lumbar vertebra	3 1959	76.3	11.7	6.20	0.02	0.16	0.43
72 years	F	Lumbar vertebra	3 1959	58.5	9.0	4.80	0.05	0.34	1.40
69 years	F	Lumbar vertebra	3 1959	59.5	14.9	7.93	0.09	0.40	0.86
43 years	F	Lumbar vertebra	3 1959	60.2	10.2	5.44	0.03	0.21	0.57
79 years	M	Lumbar vertebra	3 1959	82.5	15.7	8.35	0.12	0.66	1.78
80 years	F	Lumbar vertebra	3 1959	43.6	6.4	3.40	0.02	0.21	0.55
81 years	F	Lumbar vertebra	3 1959	30.6	4.5	2.40	0.03	0.20	0.54
43 years	F	Lumbar vertebra	3 1959	55.0	10.4	5.54	0.05	0.27	0.71
53 years	F	Lumbar vertebra	3 1959	53.9	10.7	5.70	0.10	0.48	1.28

TABLE XIII.—SUMMARY ST. LOUIS HUMAN BONE DATA
(Strontium-90)

	Bone μμc/gm			Ash μμc/gm			Calcium μμc/gm		
	High	Avg.	Low	High	Avg.	Low	High	Avg.	Low
I. Fetal and stillborn: Total 8 specimens	0.17	0.13	0.07	0.59	0.45	0.30	1.48	1.20	0.77
II. Infant 0-1 year: Total 5 specimens	0.29	0.18	0.05	1.15	0.75	0.26	3.04	1.99	0.70
III. Children 1-10 years: Total 11 specimens	0.31	0.12	0.02	1.23	0.57	0.08	3.30	1.54	0.21
IV. Adolescents 11-20 years: Total 5 specimens	0.11	0.07	0.01	0.67	0.35	0.04	1.79	0.93	0.09
V. Adults over 20 years: Total 28 specimens	0.12	0.04	0.00	0.66	0.22	0.002	1.78	0.59	0.005

TABLE XIV.—COMPARISON OF STRONTIUM-90 ACTIVITY IN HUMAN BONES OF ST. LOUIS AREA AND NORTH AMERICA*

Age	St. Louis Area Sr-90 μμc/gm Ca	North America Sr-90 μμc/gm Ca
Fetus	1.20 (8)	0.92 (59)
0-1	1.99 (5)	2.50 (15)
1-10	1.54 (11)	1.66 (30)
11-20	0.93 (5)	0.84 (23)

Note.—Figures in parentheses are number of specimens in each age group from which averages are derived.

* From the Third Quarterly Statement on Fallout by the Atomic Energy Commission, January 1960, as reported by the Geochemical Laboratory, Lamont Geological Observatory, Columbia University.

PUBLIC HEALTH SERVICE--RADIOCHEMICAL ANALYSES OF FOOD

The following data are abstracted from "Radionuclides in Foods" presented at the Annual Meeting of the Ohio Dietetic Association, Cincinnati, Ohio, May 5-6, 1960, a paper by Conrad P. Straub, G. K. murthy and J. E. Campbell of the Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio. All food items were from the Cincinnati, Ohio markets. The radiochemical analyses were performed by the PHS Robert A. Taft Sanitary Engineering Center.

TABLE XV.--CALCIUM AND STRONTIUM-90 CONTENT OF FOODS

(Cincinnati, Ohio)

Foods	Origin	Date of sampling	Ca (gm/kg)	Sr^{90} ($\mu\mu c$/kg)
Beets	Texas	3-12-59	0.120	10.3
Broccoli	California	3-12-59	1.127	5.3
Cabbage	Texas	3-12-59	0.355	7.1
Carrots	California	3-12-59	0.363	4.1
Cauliflower	California	3-12-59	0.196	2.3
Celery	California	3-12-59	0.620	2.8
Coconut	South Sea	3-12-59	0.128	1.7
Cucumber	Michigan	9-23-59	0.111	13.3
Kale	?	3-12-59	0.785	74.7
Lettuce	California	3-12-59	0.183	1.4
Mustard greens	?	9-23-59	1.422	40.0
Potato	Idaho	3-12-59	0.100	1.4
Radish	Florida	3-12-59	0.256	3.4
Spinach	Texas	3-12-59	1.406	36.5
String beans	Florida	3-12-59	0.515	43.2
Sweet potato	Tennessee	3-12-59	0.241	13.5
Turnip	Florida	3-12-59	0.422	10.6
Turnip greens	Florida	9-23-59	2.703	32.0
White flour	Minnesota	3-12-59	0.513	25.2
Whole wheat flour	Minnesota	9-23-59	0.266	56.2
Whole wheat flour	Minnesota	1- -60	0.328	47.5

TABLE XVI.—CALCIUM, POTASSIUM, GROSS β-AND SPECIFIC RADIONUCLIDE CONTENT OF FOODS

(Cincinnati, Ohio)

Sample	Date of sampling	Ca (gm/kg)	K (gm/kg)	Gross β-activity	Sr^{89}	Sr^{90}	Ba^{140}(a)	Cs^{137}(b)	Ra^{226}	Zn^{65}	Zr^{95} Nb^{95+}	Ru^{106} Rh^{106+}
				μμc/kg								
Eggs	9-23-58	0.695	1.369	1,360	-	3.0	0	2.0	0.52	6	0	0
Fruits	8-28-58	0.178	2.484	2,190	-	3.7	2.4	63.4	-	3	6	22
Fruit juices	9-23-58	0.128	1.791	1,780	-	2.1	0	31.2	0.08	-	-	-
Pastries	7-23-58	0.428	1.307	1,180	0	10.6	0	75.0	0.28	-	5	15
Cereals	6-12-58	0.480	1.365	2,540	-	12.4	0	113.5	0.12	-	50	134
Dairy products	7-16-58	4.836	-	540	61	39.0	0	21.2	0	-	-	-
Sea foods	7-16-58	0.335	-	2,310	0	0.2	0	24.8	-	-	-	-
Meats	8-27-58	0.172	3.483	2,520	0	1.0	0	160.0	0.10	17	6	26
Leafy vegetables	8-4-58	0.508	3.404	2,840	21	3.9	12.2	49.0	0	12	69	220
Root vegetables	8-4-58	0.273	3.632	3,230	46	12.5	2.8	53.3	0	10	13	60
Legumes and corn	8-4-58	0.234	3.132	3,240	32	7.5	0	57.0	0	4	13	83
Instant coffee	6-20-58	1.900	44.280	40,100	31	19.0	0	1,860.0	-	-	58	0
Instant tea	7-23-58	0.150	45.320	45,300	150	60.0	-	894.0	-	-	420	1,150
Mixed nuts	8-26-58	0.727	6.975	6,300	-	8.2	0	348.0	2.23	-	-	-
	9-23-58	0.643	6.650	6,110	6	8.1	0	208.0	0.19	-	-	-
Rice	8-26-58	0.196	0.811	740	-	1.2	0	95.0	0	-	5	19
Milk	1958	1.145			55	8.5	24	75.0	0	4	0	0

(a) Uncorrected for decay to time of collection.
(b) In ash only.
- Not determined.
0 Means below detectability.

TABLE XVII.–CALCIUM AND STRONTIUM-90 CONTENT OF MEALS

(Cincinnati, Ohio)

Sample No.	Date of sampling	Ca (gm/meal)	Sr^{90} ($\mu\mu c$/meal)
	Lunch		
1	October 1959	0.268	6.1
2	November 1959	0.158	6.5
3	November 1959	0.352	6.7
4	November 1959	0.261	7.7
5	November 1959	0.173	2.2
6	December 1959	0.242	2.6
7	December 1959	0.510	6.8
8	January 1960	0.259	4.3
9	January 1960	0.116	2.1

Meal No. 1--Tossed salad with dressing (34.5 g), Frankfurters (105.7 g), Creamed Potato (193.2 g), Peas (76.4 g), White Bread (43.1 g), Butter (5.0 g) and Milk (250.0 g). Total (707.9 g).

Meal No. 2–Eggs, celery and lettuce salad (82.7 g), Roast beef (121.4 g), Rice (139.0 g), Creamed green beans (114.4 g), rye bread (41.3 g), Cherry pie (150.7 g), and Coffee with cream and sugar (162.7 g). Total (812.2 g).

Meal No. 3–Tossed salad with dressing (73.6 g), Roast pork (144.3 g), Peas (80.9 g), Beets (68.3 g), 1 rye and 1 white bread (41.8 g), Creamed potatoes (90.5 g) and Milk (250.0 g). Total (749.4 g).

Meal No. 4--Strawberry flavored jello (159.2 g), Fried chicken (104.5 g), Candied carrots (108.0 g), mustard greens (102.0 g), white bread (38.5 g), butter (5.0 g), pineapple (144.5 g) and hot tea (161.5 g). Total (823.2 g).

Meal No. 5--Fried fish with tartar sauce (89.8 g), mixed vegetables–corn, carrots, lima beans and string beans (118.1 g), stewed tomatoes (94.1 g), rye bread (43.0 g), butter (5.0 g), pineapple pudding with whipped cream and chocolate chip (110.1 g) and vegetable juice (186.5 g). Total (647.1 g).

Meal No. 6--Chopped liver, lettuce sandwich (95.3 g), split pea soup (219.2 g), peach pie (171.6 g) and Milk (177.8 g). Total (663.9 g).

Meal No. 7--Spaghetti with cheese (208.0 g), tossed salad with dressing (80.0 g), carrots (91.3 g), bread (40.2 g), butter (5.0 g) and milk (245.6 g). Total (669.8 g).

Meal No. 8--Roast beef sandwich: 2 slices of bread (34.8 g), roast beef (47.3 g), gravy (63.0 g), milk (244 g), french fried potatoes (142.3 g). Total (531 g). Ash 5.18 g

Meal No. 9--Fish sandwich: 2 slices of bread (33.6 g), fish (88.0 g), tossed salad with french dressing (106 g), fruit jello (223.2 g), coffee with cream and sugar (142.8 g). Total (593.6 g). Ash 4.76 g

TABLE XVIII.–CALCIUM AND STRONTIUM-90 CONTENT OF MEALS

(Cincinnati, Ohio)

Sample No.	Date of sampling	Ca (gm/meal)	Sr^{90} ($\mu\mu c$/meal)
	Breakfast		
1	January 1960	0.136	2.0
2	January 1960	0.597	3.9
3	January 1960	0.310	5.1
4	January 1960	0.310	3.7
5	January 1960	0.397	5.4
6	January 1960	0.122	1.2
7	January 1960	0.200	3.4
8	January 1960	0.279	4.5

Meal No. 1--Fried eggs (92.3 g), Buttered Toast (40.1 g), Sausage (89.1), Apple Jelly (12.6 g), and Coffee, black with sugar (143.5 g). Total (377.6 g).

Meal No. 2--Bacon (24.2 g), Pancakes (200.7 g), Corn Syrup (58.0 g), Coffee, black with sugar (136.5 g). Total (419.4 g).

Meal No. 3--Doughnuts (103.7 g) and Milk (245.7 g). Total (349.4 g).

Meal No. 4--Grapefruit Juice (185.2 g), 2-Fried Eggs (102.0 g), Buttered Toast (64.2 g), Jelly (17.5 g), and Milk (244.5 g). Total (613.4 g).

Meal No. 5--Orange Juice (178.2 g), Cornflakes with Milk (181.5 g), Milk (245.0 g), and Coffee (165.4 g). Total (770.1 g).

Meal No. 6--Stewed Prunes (171.5 g), 1-Fried Egg (39.8 g), Ham (63.3 g), Buttered Toast (67.6 g), Jelly (11.3 g) and Coffee (160.2 g). Total (513.7 g).

Meal No. 7--Tomato Juice (175.2 g), Oatmeal with Milk and Sugar (387.3 g), Buttered Toast (68.2 g), Jelly (15.1 g), Coffee (169.3 g). Total 815.1 g.

Meal No. 8--Cornflakes (30.1 g), Milk (150.4 g), 1 Egg (39.0 g), 3 Strips of Bacon (15.9 g), Buttered Toast (66.5 g) and Coffee (157.1 g). Total (459.0 g).

101<

TABLE XIX.—STRONTIUM-90 ANALYSIS OF CEREALS

(Purchased at Cincinnati, Ohio)

Type cereal	Date of purchase	Strontium-90 μμc/kg
Brand A 100 percent bran	April 5, 1960	94.5 ± 3.2
Brand B All-bran	April 5, 1960	70.5 ± 2.8
Brand B 40 percent bran flakes	April 5, 1960	27.8 ± 1.4
Brand C 40 percent bran flakes	April 5, 1960	25.2 ± 1.3
Brand D shredded wheat	April 5, 1960	16.0 ± 1.1
Brand A shredded wheat	April 5, 1960	11.9 ± 0.6

RADIOACTIVITY IN FISH

Minnesota Department of Conservation

The Minnesota Department of Conservation has reported the results of their studies extending from early 1958 through July 1959 on the levels of radioactivity in fish in the State of Minnesota. The average values of "whole fish' for this period of time were reported as follows:

μμc strontium-90/Kg whole fish........................	131
μμc strontium-90/grams calcium whole fish......	17.2

Of particular interest were the results of analyses of different parts of six fish. These data are contained in Table XX.

102<

TABLE XX.–STRONTIUM-90 LEVELS IN MINNESOTA FISH

Date collected	Species and Lab. No.	Waste				Bones				Flesh				Skin			
		μμc Beta-activity/gm	μμc Sr^{90}/kg	μμc Sr^{90}/gmCa	gm Ca/kg	μμc Beta-activity/gm	μμc Sr^{90}/kg	μμc Sr^{90}/gmCa	gm Ca/kg	μμc Beta-activity/gm	μμc Sr^{90}/kg	μμc Sr^{90}/gmCa	gm Ca/kg	μμc Beta-activity/gm	μμc Sr^{90}/kg	μμc Sr^{90}/gmCa	gm Ca/kg
7/58	Walleye ...7139	0.32	50.1	3.1	6.0	19	700	6.9	101	4.5	10.9	14.9	0.73	0.36	7.9	12.9	0.61
7/58	Crappie ...7507	6.3	580	27.9	20.6	29	2,100	25.6	86.6	0.04				0.87			
1/59	Crappie ...9570		750	30.6	24		480	20.1	24						10.7	16.9	0.65
2/59	Northern..9883	3.8	170	12.3	14	2.3	420	15.5	27	2.3	7.2	15.2	0.48	2.3	27	24.8	1.1
4/59	Northern.....21	3.6	160	10.6	15	4.9	260	8.3	32	44	3.9	11.1	0.35	2.5	6.6	8.5	0.77
4/59	Northern.....45	4.1	160	9.9	17	7.1	400	8.2	49	4.0	26	15.6	1.6	2.5	16	13.5	1.2

FISSION PRODUCTS RADIOACTIVITY IN SOIL

Argonne National Laboratory
Atomic Energy Commission

For about the past three years, analyses of soil samples have been collected periodically near Argonne National Laboratory and analyzed for gamma emitting fission products, by Dr. Philip F. Gustafson, of ANL. These data have been reported in the Atomic Energy Commission's Quarterly Statements on Fallout and were presented at the December 1959 meeting of the Radiological Society of North America in a paper "Assessment of the Radiation Dose Due to Fallout" by Dr. Gustafson. The following six figures (numbers 70 through 75) are based on these data. The data in Table XXI were received after the preparation of the graphs. For purposes of comparison, a radiological decay curve for each radionuclide is drawn on the graph with the starting point selected arbitrarily at the time of highest soil activity for the nuclide.

By integrating under a smoothed curve connecting the points on the graphs it is possible to calculate (using Dr. Gustafson's methods) the theoretical out-of-doors gamma exposures from these radionuclides in the soil.* These exposures are summarized as follows:

(a) From May 1957 to April 1959...~90 millirads
(About 85 millirads from shorter lived radionuclides and
about 5 millirads from cesium-137)

(b) Peak year (1959)...~50 millirads

As one point of reference in interpreting the calculations, the external gamma radiation exposure from natural background is roughly 100 millirads per year. Thus, the calculated out-of-doors dose from fallout (based on these soil data) is about 1/3 of natural background for the period May 1957 to April 1959 and about 1/2 for the peak year.

The calculated out-of-doors dose rate in April 1960 was roughly 1.6 millirads per month, or about 1/5 that of natural background. In the absences of further atmospheric nuclear weapons testing, it would be expected that the downward trend of dose rates would continue since the radiological decay of the radionuclides more than compensate for the small additional deposition from the atmosphere. Eventually, of course, the gamma does rate will level off to that of cesium-137 (half-life of 27 years).

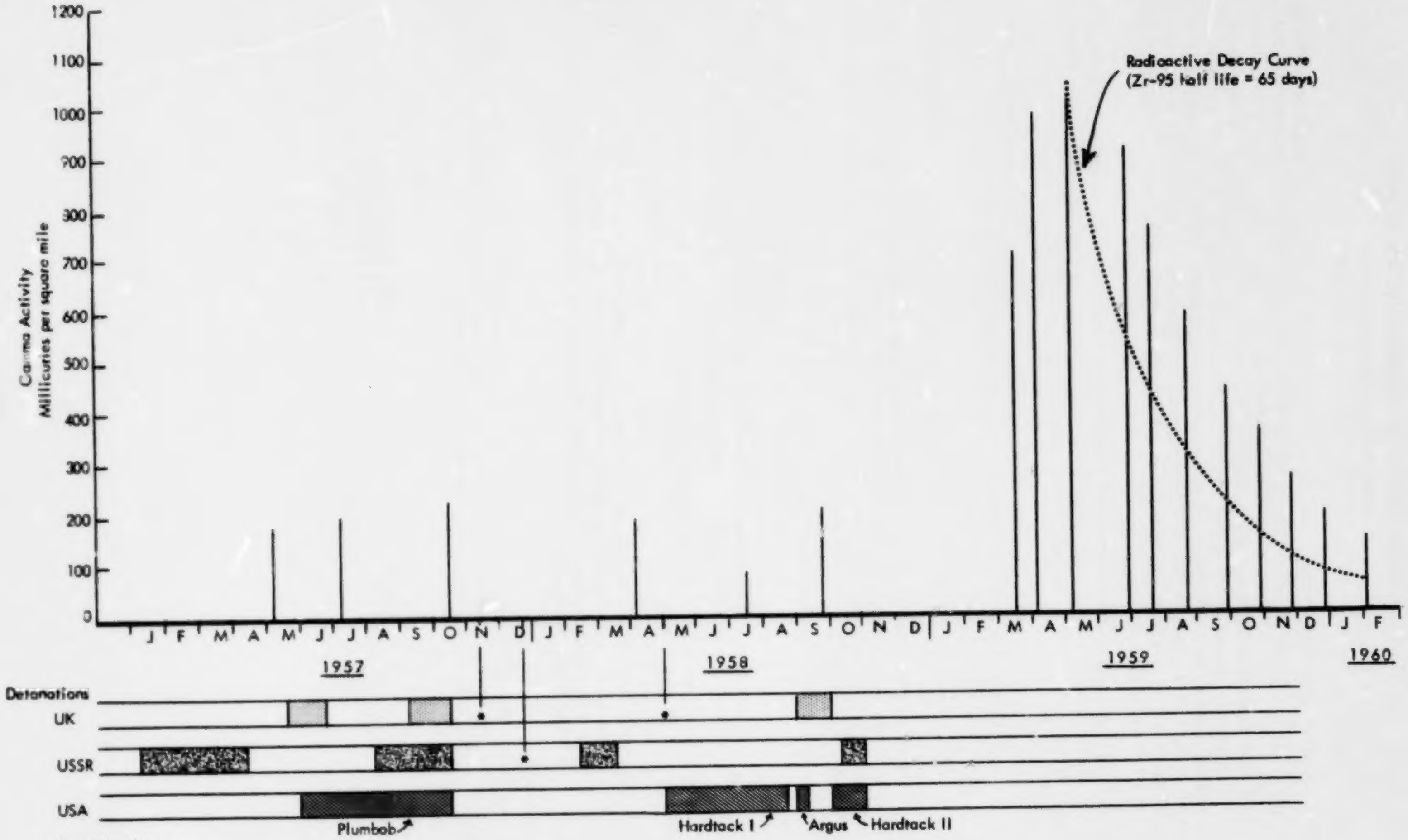
The shielding effect of normal structures will reduce the in-door radiation exposures from those calculated out-of-doors. Using an ionization chamber Dr. Gustafson found a reduction factor of approximately five for in-door dose rates compared to those of out-of-doors. The structures used for this test were relatively large frame buildings or were of the cinder-block construction. It would be expected that a more usual frame home would have somewhat less shielding effects. The actual radiation exposure that persons might receive would depend, of course, not only on the type of structure but also on the length of time it was occupied.

---

*Barium^{140}-lanthanum^{140} were not measured but it would be expected that these would contribute some additional gamma exposure. Although their half-lives are relatively short (12.8 days and 40 hours) they are present initially in relatively great abundance in fission products.

FIGURE 70

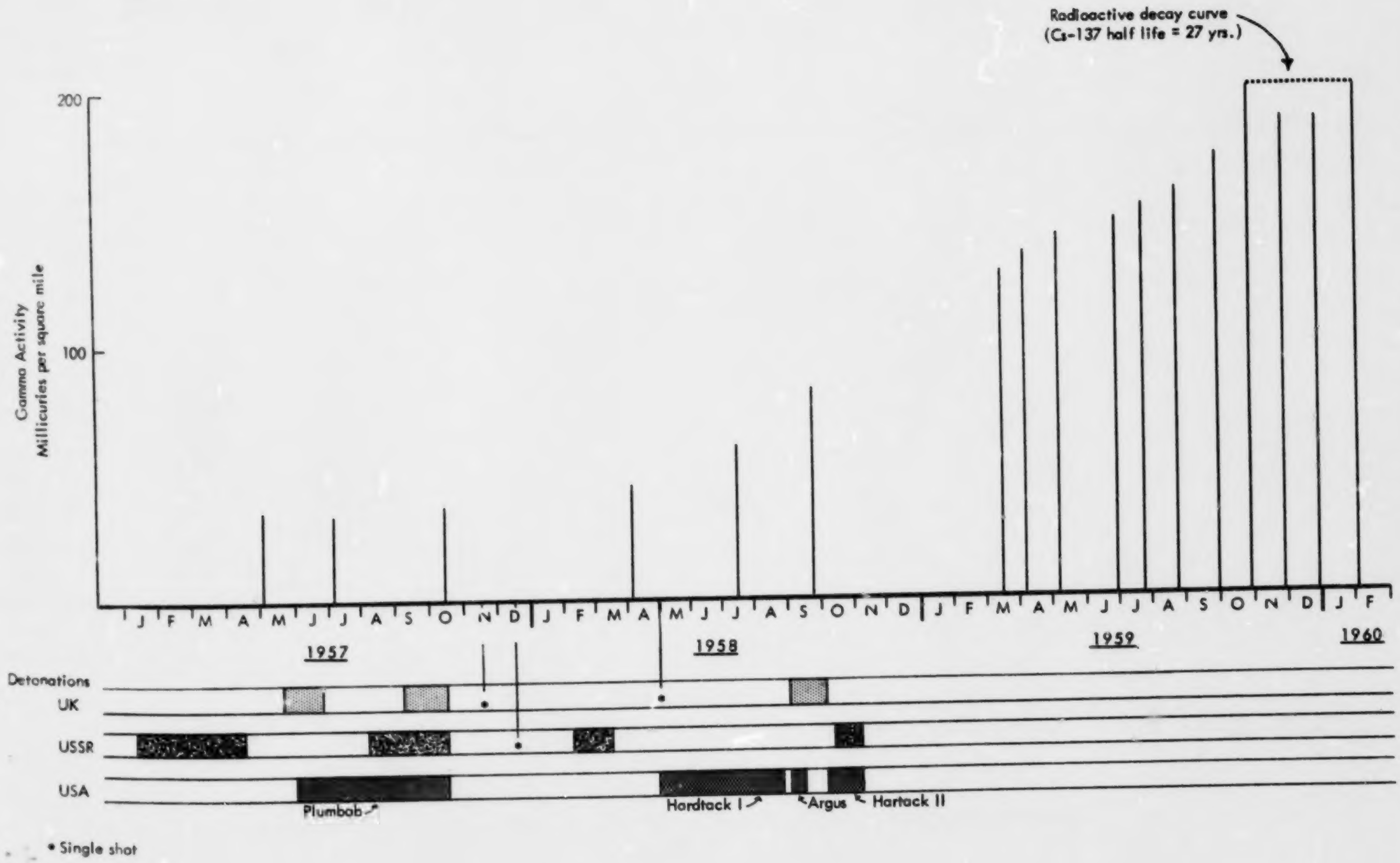
ZIRCONIUM-95 -NIOBIUM-95 RADIOACTIVITY IN SOIL AT ARGONNE NATIONAL LABORATORY**



* Single shot
** Activity of Zirconium-95 (assuming that Zirconium-95 and Niobium-95 are in equilibrium)

FIGURE 71

CESIUM-137 RADIOACTIVITY IN SOIL AT ARGONNE NATIONAL LABORATORY



107

FIGURE 72
RUTHENIUM-106 RADIOACTIVITY IN SOIL AT ARGONNE NATIONAL LABORATORY

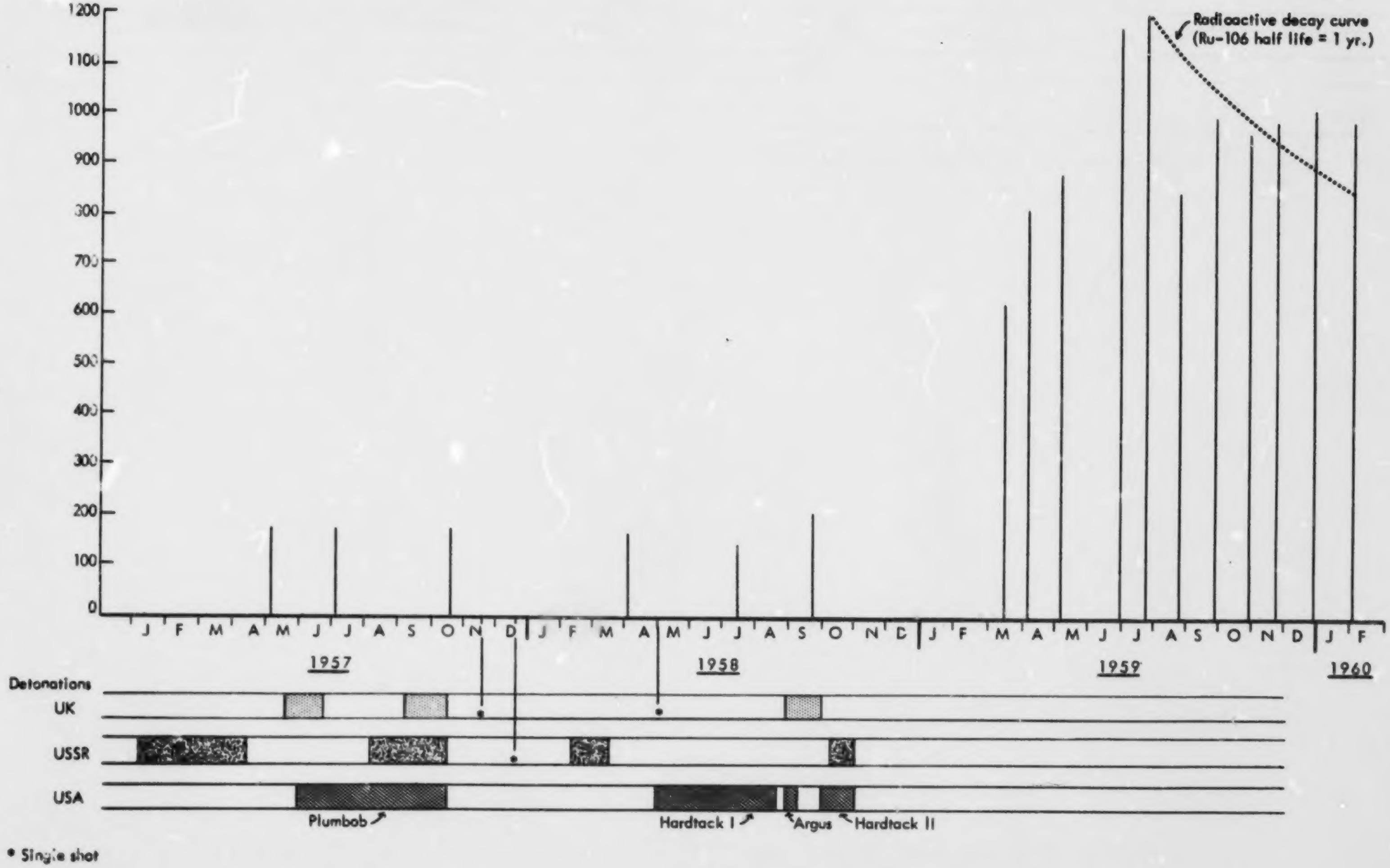


FIGURE 73

RUTHENIUM-103 RADIOACTIVITY IN SOIL AT ARGONNE NATIONAL LABORATORY

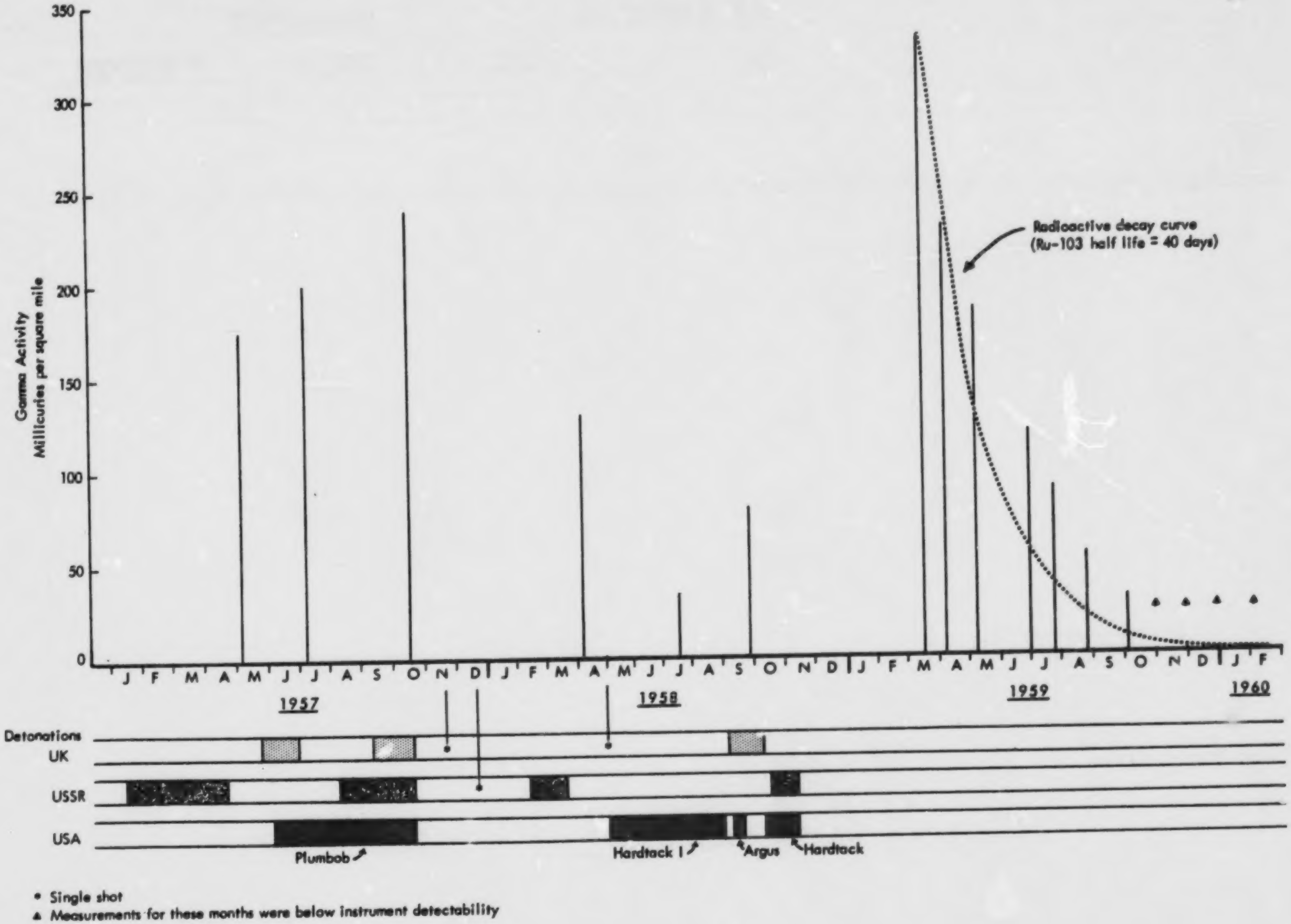


FIGURE 74

CERIUM-141 RADIOACTIVITY IN SOIL AT ARGONNE NATIONAL LABORATORY

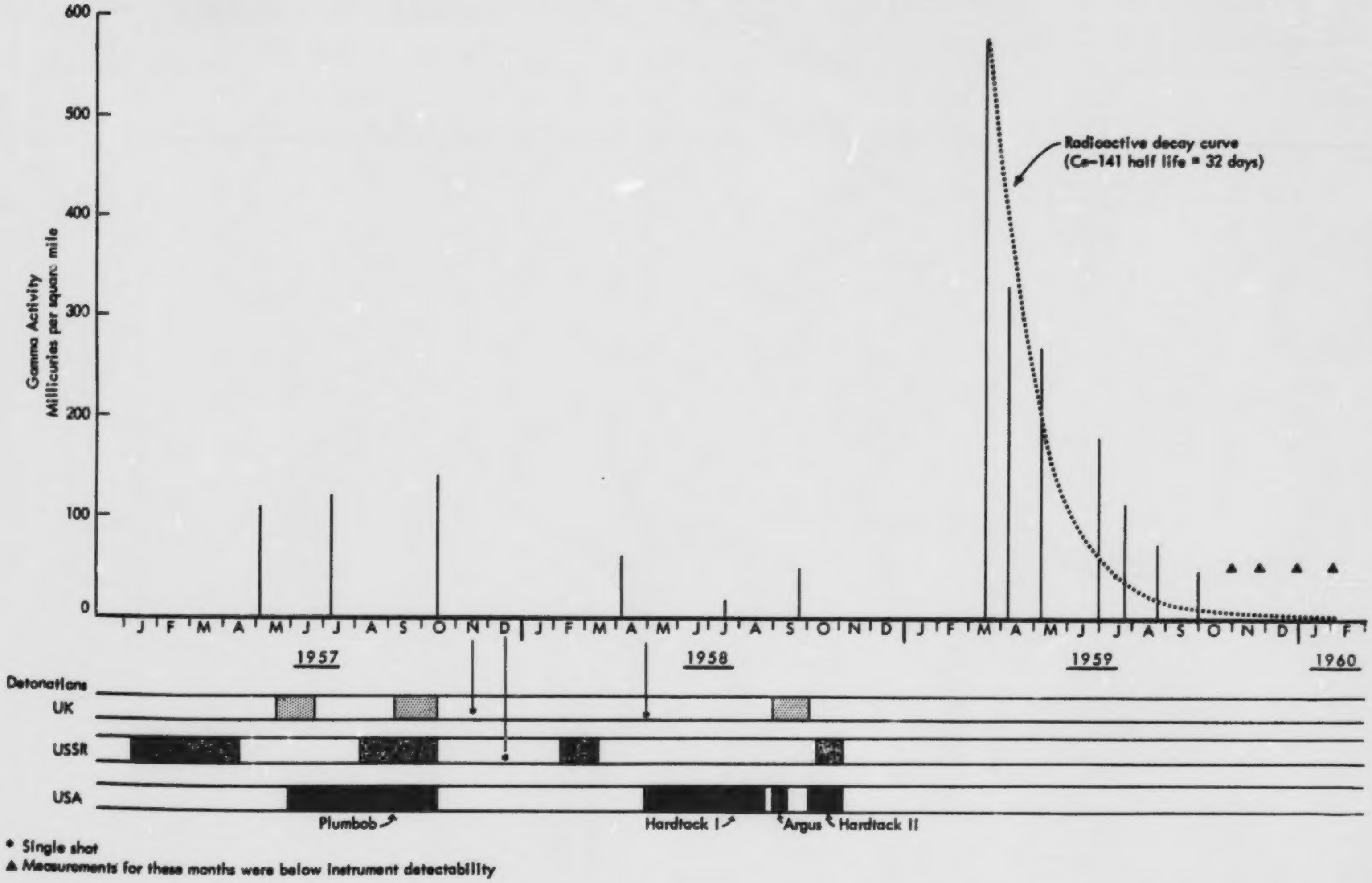


FIGURE 75

CERIUM-144 RADIOACTIVITY IN SOIL AT ARGONNE NATIONAL LABORATORY

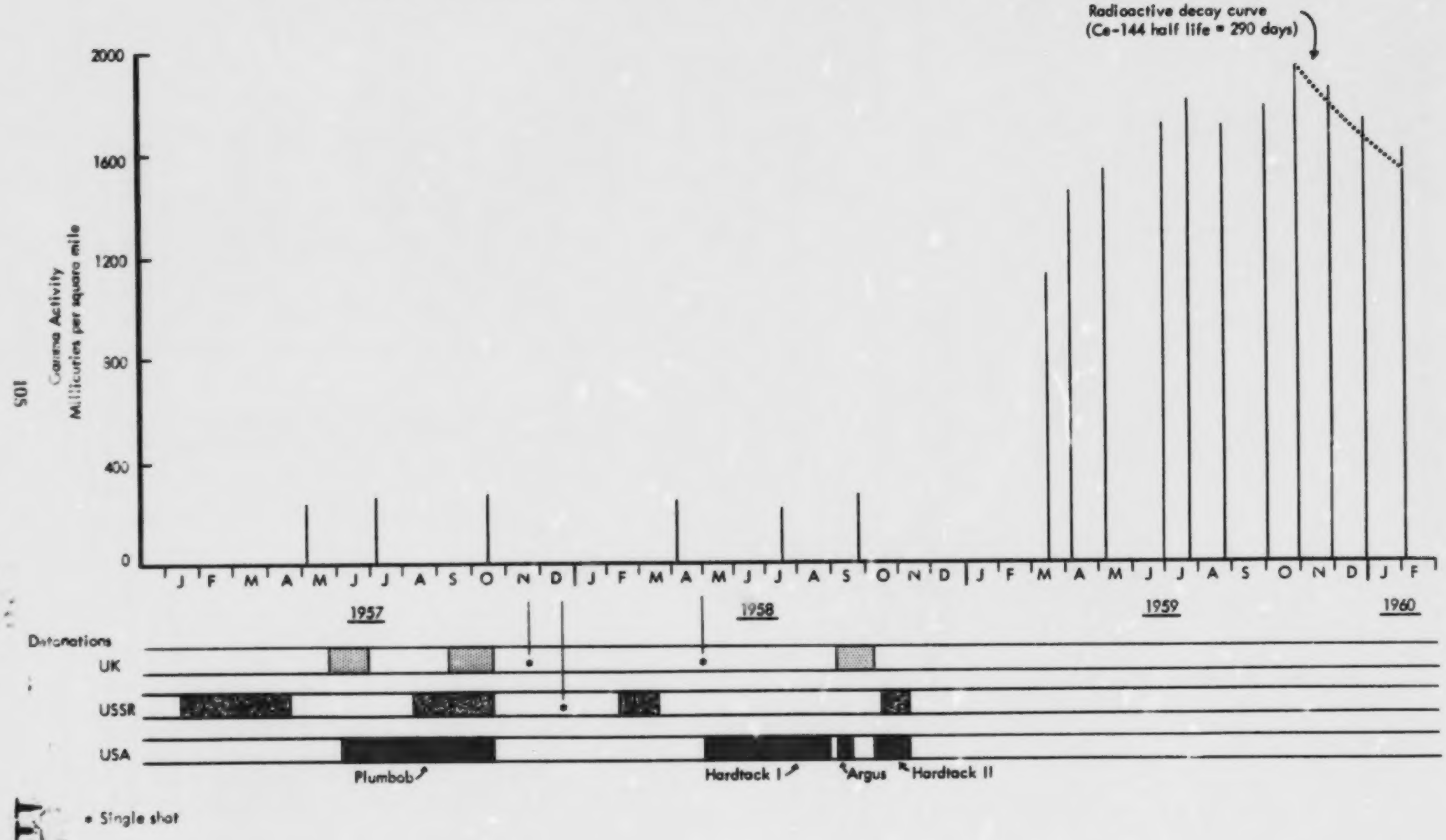


TABLE XXI.—FISSION PRODUCT RADIOACTIVITY IN SOIL AT ARGONNE NATIONAL LABORATORY

(Millicuries per square mile)

Isotopes	Collection dates	
	March 2, 1960	April 11, 1960
Zr^{95}-Nb^{95}	112	90
Cs^{137}	195	197
Rw^{106}	950	915
Ru^{103}	-	-
Ce^{141}	-	-
Ce^{144}	1,610	1,650

EXTERNAL GAMMA ACTIVITY PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Portable survey instruments are available at the stations of the Radiation Surveillance Network and one of their uses is to record external gamma radiation. These readings are not precise, especially for measurement of low levels but they can show the presence or absence of any significant increases above background. The differences among the values shown on the following table are within the variances anticipated due to differences in normal background and in instrument response characteristics.

TABLE XXII.—EXTERNAL GAMMA ACTIVITY

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Milliroentgens per hour—at three feet above the ground
For month of February 1960

Station location	Average	Station location	Average
Alaska, Anchorage	0.01	Minnesota, Minneapolis	0.01
Alaska, Fairbanks	0.01	Mississippi, Pascagoula	(*)
Alaska, Juneau	0.02	Missouri, Jefferson City	0.01
Arizona, Phoenix	0.01	Montana, Helena	0.02
Arkansas, Little Rock	0.02	New Jersey, Trenton	0.02
California, Berkeley	(*)	New Mexico, Santa Fe	0.04
California, Los Angeles	0.01	New York, Albany	0.02
Colorado, Denver	0.02	North Carolina, Gastonia	0.02
Connecticut, Hartford	0.01	Ohio, Cincinnati	(*)
District of Columbia	0.02	Oklahoma, Oklahoma City	0.02
Florida, Jacksonville	0.02	Oklahoma, Ponca City	0.04
Georgia, Atlanta	0,02	Oregon, Portland	0.02
Hawaii, Honolulu	0.02	Pennsylvania, Harrisburg	(*)
Idaho, Boise	(*)	Rhode Island, Providence	0.02
Illinois, Springfield	(*)	South Carolina, Columbia	0.02
Indiana, Indianapolis	0.01	South Dakota, Pierre	0.02
Iowa, Iowa City	0.01	Texas, Austin	0.02
Kansas, Topeka	0.02	Texas, El Paso	0.02
Louisiana, New Orleans	0.02	Utah, Salt Lake City	0.02
Maryland, Baltimore	0.02	Virginia, Richmond	0.01
Massachusetts, Lawrence	0.02	Washington, Seattle	0.02
Michigan, Lansing	0.02	Wyoming, Cheyenne	0.02

*No data received.

ENVIRONMENTAL RADIOACTIVITY—SHIPPINGPORT ATOMIC POWER STATION

The first commercial atomic power reactor to go into operation in the United States was at Shippingport, Pennsylvania. On June 1, 1960, the U. S. Atomic Energy Commission through its Pittsburgh Naval Reactors Operations Office, issued its report on environmental radioactivity for the calendar year 1959. Believing that this report on environmental radioactivity associated with the first commercial atomic power reactor will be of general interest, it is reproduced below.

SUMMARY OF ENVIRONMENTAL RADIOACTIVITY AT THE SHIPPINGPORT ATOMIC POWER STATION

For Calendar Year 1959

PNROO-DEV-100

Report to Pennsylvania Department of Health
By U. S. Atomic Energy Commission
Pittsburgh Naval Reactors Operations Office, Pittsburgh, Pa.

June 1, 1960

The Shippingport Atomic Power Station is the world's first large scale nuclear power electrical generating station and is operated for the Atomic Energy Commission by the Duquesne Light Company. For two years prior to the plant's initial operation in December, 1957, an environmental radiation survey was conducted in the Shippingport area by the Atomic Energy Commission in order to establish reliable data on radiation levels in the area prior to plant completion. This program has been continued during the operation of the station. To limit the amounts of radioactivity reaching the surrounding areas, stringent controls on reactor operation are maintained at all times in addition to the safety features that have been designed into the plant. The environmental radiation survey serves as a check on plant operation and has thus far indicated that controls and design features have been completely adequate to minimize radioactivity released to the environment.

During 1959, the plant operated at various power levels for nearly 3,500 hours and produced over 201 million kilowatt-hours gross electrical energy.

The liquid and gaseous discharge from Shippingport are controlled so that concentrations of radioactivity added by the plant to background radioactivity levels do not exceed those recommended by the National Committee on Radiation Protection (NCRP). The criteria established by this Committee are considered to be the best available and have been adopted by such groups as the AEC, U. S. Public Health Service and the Pennsylvania Department of Health. In addition, the Duquesne Light Company as operator of Shippingport, has a permit granted by the State of Pennsylvania to discharge limited amounts of liquid radioactive wastes to the Ohio River. These limits are such to insure that permissible concentrations as established by the NCRP and Pennsylvania Regulation 433 are not exceeded.

LIQUID RADIOACTIVE WASTE DISPOSAL

The limits for discharge of radioactive wastes at Shippingport are based on criteria which depend on a knowledge of the radioactive materials which make up the waste. If the quantity of a particular radioactive species is known, the discharge of that particular species may be based on the limit for that individual material. If the quantities of specific radioactive isotopes are not identified, then a more stringent limit for gross unknown mixtures of radioactive material is used. At Shippingport, most of the wastes are discharged according to the limit for gross unidentified mixtures of radioactivity. This is now done because the total quantity of radioactivity in the waste is low and analysis for many specific radioactive isotopes is laborious and expensive. However, the discharge of a known lower hazard radioactive isotope called tritium is controlled separately based on its own limit since its formation in the reactor plant can be predicted with relative ease.

The waste discharge criteria for the plant impose the restriction that radioactivity released to the environment does not increase the background radioactivity levels by more than 10 percent of the permissible concentrations recommended by the NCRP. This factor of 10 to the NCRP recommended permissible concentrations is usually applied for areas outside an atomic energy installation. At Shippingport this criterion is applied to the actual plant discharges and no allowance is made for the dilution available in the environment except for that river water actually pumped through the plant for cooling the condensers.

The following table shows the average total daily discharges of gross radioactivity to the Ohio River during 1959:

	Gross radioactivity average total daily discharge, μc/day*
First quarter	97.2
Second quarter	73.4
Third quarter	192.2
Fourth quarter	536.4

---

*Microcuries per day.

Maximum discharge in one day was 3,712.8 microcuries.

The average total daily allowable discharge of unidentified mixtures of radioactivity according to the Pennsylvania waste permit is 1,590 microcuries per day. The maximum total daily allowable discharge according to the Pennsylvania waste permit is 6,200 microcuries in any one day.

The average total daily discharges of the lower hazard radioactive isotope tritium during 1959 were as follows:

	Average daily total discharge of tritium, curies per day
First quarter	0.18
Second quarter	0.21
Third quarter	0.19
Fourth quarter	0.11

Maximum discharge in any one day was 3.6 curies.

The average total discharge of tritium allowed per day under the Pennsylvania waste permit is 10 curies. The maximum total discharge of tritium allowed in any one day under the Pennsylvania waste permit is 50 curies.

Average concentrations of Shippingport radioactive waste discharges to the Ohio River during 1959 are summarized below. These averages were computed using the measured total quantities of radioactivity, the known amount of dilution water from the plant, and the known waste discharge time periods. These average concentrations are in addition to the background radioactivity in the river water pumped through the turbine-generator plant condenser for cooling purposes, and also used for dilution of the radioactive liquid wastes.

	Average concentration of gross radioactivity in effluent channel μc/cc*	Average concentration of tritium in effluent channel μc/cc*
First quarter	1.7×10^{-9}	2.1×10^{-5}
Second quarter	1.4×10^{-9}	2.1×10^{-5}
Third quarter	2.8×10^{-9}	0.85×10^{-5}
Fourth quarter	5.2×10^{-9}	0.52×10^{-5}

---

*Microcuries per cubic centimeter.

The maximum concentration of gross radioactivity at any one time during the year was 1.2×10^{-8} μc/cc. This concentration was discharged for 1 1/2 hours on December 16, 1959. All other discharges during 1959 were less than 1×10^{-8} μc/cc. The minimum concentration of gross radioactivity during a waste discharge was 1×10^{-11} μc/cc which occurred several times during the year.

The criterion for continuous discharge of unidentified mixtures of radioactive materials from Shippingport to the Ohio River is 1×10^{-8} μc/cc. This is one-tenth of the permissible concentration for unknown mixtures of radioisotopes in drinking water as recommended by the National Committee on Radiation Protection (NCRP) for lifetime consumption. One-tenth of the permissible concentration for tritium recommended by the NCRP is 3×10^{-3} μc/cc.

The liquid radioactive wastes from Shippingport during 1959 have not shown a detectable effect on the background radioactivity level of Ohio River water. The average concentration of gross radioactivity added to the effluent leaving the plant was appreciably lower than both the permissible concentration and the background river water radioactivity level upstream. Variations in background river radioactivity levels are attributed to normal statistical variation and changes in meteorological conditions affecting river flow. Tritium discharges were also considerably below the permissible concentration for that radioactive isotope.

Weekly composite river water samples are routinely collected at locations upstream and downstream from the waste disposal system effluent and are analyzed for gross radioactivity. The results of measurements made during 1959 are shown in the following table:

1959	Average upstream measured gross radioactivity in μc/cc*	Average downstream measured gross radioactivity in μc/cc*
First quarter....................	3.6×10^{-8}	4.8×10^{-8}
Second quarter..................	2.4×10^{-8}	2.5×10^{-8}
Third quarter	1.1×10^{-8}	1.6×10^{-8}
Fourth quarter..................	2.0×10^{-8}	1.9×10^{-8}

---

*Microcuries per cubic centimeter.

The maximum upstream gross radioactivity detected during 1959 was 9.1×10^{-8} μc/cc (microcuries per cubic centimeter) while the minimum was 9.0×10^{-10} μc/cc.

The maximum downstream gross radioactivity detected during 1959 was 1.2×10^{-7} μc/cc while the minimum was 2.9×10^{-9} μc/cc.

Radioactive waste discharges from the plant increased somewhat during the latter part of 1959 as compared with the first part, whereas Ohio River water background radioactivity levels decreased during the same period.

RELEASE OF RADIOACTIVE WASTES TO THE ATMOSPHERE

During 1959, some gaseous radioactivity was released to the atmosphere from the waste disposal system. The quantity released was less than one percent of plant design. In January, the only time gas was released, a total of 13,927 microcuries composed primarily of radioactive krypton-85 was discharged at a controlled rate over a period of 102 1/2 hours. This gaseous waste had an average concentration of 8.9×10^{-8} μc/cc of air at the stack exit during release. This was considerably less than 3×10^{-7} μc/cc which is one-tenth the permissible concentration for krypton-85 in air recommended by the National Committee on Radiation Protection for continuous life time breathing.

An incinerator for burning contaminated combustible material is located in the waste disposal plant and is generally used several times a month. The exhaust from the incinerator passes through a wet gas scrubber and a filter before entering the stack to remove any particulate radioactivity. The exhaust is monitored at the stack exit to record the level of radioactivity leaving the plant. During 1959 the maximum radioactivity monitored at the stack exit during incinerator operation was 8.7×10^{-11} uc/cc of air and the minimum was 2.4×10^{-13} uc/cc of air. These concentrations were less than the permissible concentration for such airborne particulates of 1×10^{-10} uc/cc as recommended by NCRP.

AREA MONITORING

During the Calendar Year 1959 five monitoring stations were used continuously to monitor and record background levels of beta-gamma radiation and levels of airborne particulate radioactivity in the vicinity of the Shippingport site. The data recorded by each station during this period was checked and tabulated weekly.

One of the stations is located on the Shippingport site and three are located to the north, east and south about one-half mile from the site. The locations were selected because of prevailing wind conditions. The fifth station was moved periodically to different locations.

Much of the 1959 data listed in the following table are comparable to data collected during the pre-operational survey of the Shippingport site. With the exception of one mobile station the monitoring stations were in the same locations during the pre-operational survey as they were during the Calendar Year 1959.

AVERAGE BETA-GAMMA BACKGROUND RADIATION LEVELS—1959

1959	MILLIROENTGENS PER HOUR (MR/HR)
First quarter	0.019
Second quarter	0.023
Third quarter	0.019
Fourth quarter	0.012
Average for the year	0.018 mr/hr.
Maximum recorded during the year	0.059 mr/hr. (average for a one-week period)
Minimum recorded during the year	0.005 mr/hr. (average for a one-week period)
Average for pre-operational radiation survey (1956-57).	0.016 mr/hr.

A survey made by the United States Atomic Energy Commission throughout the United States in 1957 showed that background radiation intensities in various parts of the United States varied from 0.038 milliroentgen per hour (mr/hr) to 0.028 mr/hr. Data presented in the above table indicate that the average background radiation levels in the vicinity of the Shippingport Site are well within the national range measured in 1957.

CONTINUOUS MONITORING OF AIRBORNE PARTICULATE RADIOACTIVITY

A continuous air monitor in each of the monitoring stations is used to monitor and record levels of airborne particulate radioactivity. As indicated in the following table, the average concentration of particulate radioactivity of the air in the vicinity of the Shippingport Site for 1959 is well below the maximum permissible concentration established on the basis of recommendations by the National Committee on Radiation Protection. A comparison of the airborne activity data taken in 1959 to that taken during the pre-operational survey indicates no appreciable difference in levels of airborne particulate radioactivity.

1959	Average concentration of airborne particulate radioactivity $\mu c/cc$*
First quarter	1.0×10^{-12}
Second quarter	1.4×10^{-12}
Third quarter	2.3×10^{-12}
Fourth quarter	1.7×10^{-12}
Average airborne concentration for 1959	1.5×10^{-12} $\mu c/cc$
Maximum airborne concentration detected during the year.	7.8×10^{-12} $\mu c/cc$
Minimum airborne concentration detected during the year.	7.8×10^{-14} $\mu c/cc$
Average airborne concentration during pre-operational survey (1956-57).	2.1×10^{-12} $\mu c/cc$
Maximum permissible concentration**	1.0×10^{-10} $\mu c/cc$

---

*Microcuries per cubic centimeter of air.

**The maximum permissible concentration for air established on basis of NCRP recommendations (NBS Handbook 69).

FALLOUT

Trays to collect fallout from the atmosphere are placed at each of the five area monitoring stations. Each tray is equipped with a special gummed paper on which the fallout is collected. The samples are collected and analyzed weekly for gross beta radioactivity. The results of this sampling program for 1959 are presented in the following table:

Average Beta Radioactivity in Fallout

Expressed in mc/mi^2/mo.*

	STATIONS	
1959	2-3-5 upwind	1-4 downwind
First quarter	298	308
Second quarter	198	227
Third quarter	19.3	24.6
Fourth quarter	9.5	6.1

Maximum concentration upwind	374 mc/mi^2/mo.
Minimum concentration upwind	1.9 mc/mi^2/mo.
Maximum concentration downwind	420 mc/mi^2/mo.
Minimum concentration	2.2 mc/mi^2/mo.

---

*Millicuries per square mile per month.

The predominant wind direction in the vicinity of the Shippingport site is from West to East. The above data indicate that there is no significant difference between the fallout values upwind and downwind and that the contribution to fallout by the Shippingport operation is negligible.

SOIL SAMPLING

Soil samples are collected quarterly from twenty locations within a radius of approximately five miles of the Shippingport site. A comparison of the data taken in 1959 with that data taken during the pre-operational survey shows no significant increase in concentrations.

1959	Average concentration of alpha activity in soil samples in μc/gram*	Average concentration of beta activity in soil samples in μc/gram*
First quarter	1.72×10^{-5}	1.77×10^{-5}
Second quarter	1.85×10^{-5}	2.06×10^{-5}
Third quarter	1.88×10^{-5}	1.68×10^{-5}
Fourth quarter	1.55×10^{-5}	1.69×10^{-5}

Average alpha concentration for 1959	1.75×10^{-5} μc/gram
Average beta concentration for 1959	1.80×10^{-5} μc/gram
Maximum alpha concentration for 1959	3.34×10^{-5} μc/gram
Minimum alpha concentration for 1959	8.1×10^{-6} μc/gram
Maximum beta concentration for 1959	3.79×10^{-5} μc/gram
Minimum beta concentration for 1959	0.96×10^{-5} μc/gram
Average alpha concentration during pre-operational survey (1956-57)	1.54×10^{-5} μc/gram
Average beta concentration during pre-operational survey (1956-57)	1.58×10^{-5} μc/gram

---

*Microcuries per gram of soil.

SUMMARY

Measurements of radioactivity in the air, river water, soil and fallout in the Shippingport environment show that the Shippingport Atomic Power Station did not contribute significant quantities of radioactivity to the surrounding areas.

During 1959 the average concentration of gross radioactivity in the liquid effluent was 2.8×10^{-9} $\mu c/cc$ in addition to background radioactivity while the average concentration of tritium discharged was 1.4×10^{-5} $\mu c/cc$. Both of these values are within the standards for drinking water established by the National Committee on Radiation Protection and Pennsylvania Regulation 433. The average concentration of gross radioactivity in the Ohio River varied between 1.1×10^{-8} to 3.6×10^{-8} $\mu c/cc$ in samples collected upstream from the plant and from 1.6×10^{-8} to 4.8×10^{-8} $\mu c/cc$ downstream. The apparent higher downstream levels cannot be attributed to waste discharges from Shippingport because the radioactivity levels in the river were lowest at the times when the quantity of wastes released was highest. A review of the concentrations in the effluent during discharge confirms this. The differences are believed to be due to normal statistical variation often found in low level radioactivity monitoring of this type.

Release of radioactive material to the atmosphere was minimal during 1959 as can be ascertained from a review of the monitoring results of gaseous waste disposal discharges and incinerator operation. Continuous monitoring of airborne particulate radioactivity in the atmosphere of the area indicated an average concentration of 1.5×10^{-12} $\mu c/cc$ for 1959. This value is within the maximum permissible concentration of 1×10^{-10} $\mu c/cc$ recommended by NCRP for unidentified radioactive materials in air. The average beta-gamma background radiation level for the Shippingport area in 1959 was 0.018 milliroentgens per hour. This is within the background ranges measured in the U. S. in 1957 by the AEC.

Measurements of the concentrations of radioactivity in soil samples showed little change when compared with similar data obtained during similar surveys made prior to plant operation. No significant contribution to either soil radioactivity levels or radioactive fallout levels from Shippingport was evident during 1959. Fallout values obtained generally downwind from the plant did not vary significantly from those obtained upwind which indicated no contribution to fallout levels from Shippingport. Measurements of fallout showed a general decrease in levels during the year.

62597--U.S.Dept.of Comm--DC--1960

RADIOLOGICAL HEALTH DATA

MONTHLY REPORT

AUGUST 1960

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Division of Radiological Health

118<

PREFACE

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned, among other things, primary responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. Within the Department this responsibility has been delegated to the Division of Radiological Health, Public Health Service.

As a step in the discharge of this responsibility, the Public Health Service is publishing *Radiological Health Data*. This publication is issued monthly, with each third issue (starting July 1960) expanded somewhat into a quarterly report.

The monthly and quarterly reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
Department of Commerce
Department of Agriculture

TABLE OF CONTENTS

Page

PREFACE iii

SECTION I.–MILK 1

Description of Public Health Service Milk Monitoring Program 1
Data on Radioactivity in Milk (March 1960)–Public Health Service Milk Monitoring Program..... 2
Data on Radioactivity in Milk (January, February and March, 1960)–Atomic Energy Commission 3

SECTION II.–AIR 4

Description of Public Health Service Radiation Surveillance Network 4
Data on Radioactivity of Particulates in Air--Gross Beta Counts (March 1960)–Public Health Service Radiation Surveillance Network..... 6
Data on Radon and Thoron Air Measurements at Cincinnati, Ohio (March 1960)--Public Health Service Radiation Surveillance Network 7
Average Measurements of Surface Air at 13 Stations Along the 80th Meridian (April 1960)–U. S. Naval Research Laboratory 7
Data on Radioactivity in the Air at Lemont, Illinois (September 1959-March 1960)--Argonne National Laboratory--Atomic Energy Commission..... 11

SECTION III.–WATER..... 12

Description of Public Health Service National Water Quality Network..... 12
Data on Radioactivity in Raw Surface Waters (February 1960)–Public Health Service National Water Quality Network 14
Data on Strontium-90 in Tap Water at Richmond, California, and New York City (December 1959-March 1960)–Health and Safety Laboratory (HASL), U. S. Atomic Energy Commission..... 16

SECTION IV.--OTHER DATA..... 17

External Gamma

Data on External Gamma Activity (March 1960)–Public Health Service Radiation Surveillance Network 17

Medicine

Radioisotopes in Medicine–Stanford Research Institute..... 18

Soils

A Selected List of Environmental Sampling Networks for Analyses of Radioactivity in Soils..... 19
Soil Networks–Methods of Publication of Data 22
Soil Networks--List of Sampling Stations 24

Food

Food Consumption of Households in United States--U. S. Department of Agriculture 26

State Activities

Summary of State Activities in Radiological Health..... 34

Short Lived Isotopes

Contribution of Short Lived Isotopes and Hot Spots to Radiation Exposure in the United States from Nuclear Test Fallout..... 44

LIST OF TABLES

I.–Radioactivity in Milk (March 1960)--Public Health Service Milk Monitoring Program..... 2
II.–Radioactivity in Milk (January, February and March, 1960)--Atomic Energy Commission..... 3
III.–Radioactivity of Particulates in Air--Gross Beta Counts (March 1960)--Public Health Service Radiation Surveillance Network 6
IV.–Radon and Thoron Air Measurements (March 1960)--Public Health Service Radiation Surveillance Network..... 7

120<

TABLE OF CONTENTS--Con.

Page

V.--Daily Record of Fission Product β-Activity Collected by Air Filtration (April 1960)--U. S. Naval Research Laboratory 8

VI.--Radioactivity in the Air at Lemont, Illinois (September 1959-March 1960)--Argonne National Laboratory--Atomic Energy Commission 11

VII.--Radioactivity in Raw Surface Waters (February 1960)--Public Health Service National Water Quality Network 14

VIII.--Strontium-90 in Tap Water, Richmond, California, and New York City (December 1959-March 1960)--Health and Safety Laboratory--U. S. Atomic Energy Commission 16

IX.--External Gamma Activity (March 1960)--Public Health Service Radiation Surveillance Network 17

X.--A Selected List of Environmental Sampling Networks for Analyses of Radioactivity in Soils 20

XI.--Food Consumption per Person in Households in the United States (1955)--U. S. Department of Agriculture 27

XII.--Summary of State Activities in Radiological Health 35

LIST OF FIGURES

1.--Public Health Service Radiation Surveillance Network Sampling Stations 5

2.--Average Measurements of Surface Air at 13 Stations Along the 80th Meridian (April 1960)--U. S. Naval Research Laboratory 10

3.--Public Health Service National Water Quality Network of Sampling Stations 13

SECTION I

MILK

PUBLIC HEALTH SERVICE MILK MONITORING PROGRAM

The U. S. Public Health Service Milk Monitoring Network presently consists of 12 sampling stations. This is being expanded to about 60 stations during the summer of 1960.

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Department of Health, Education, and Welfare to determine trends in our changing environment, including measurement of amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing since it is among the most important elements of the diet and is constantly available at all seasons of the year and in all climates. A primary objective of the project was to develop and simplify methods of collection and radiochemical analysis of milk to make them more suitable for larger scale programs.

The selection of the present 12 sampling stations was based on the following criteria:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.
2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.
3. The milk samples were from a supply that was part of a metropolitan milkshed.
4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

The Overton, Nevada and St. George, Utah milksheds do not fulfill the 1,000 cow minimum requirement but have been included since they are part of the monitoring program around the Nevada Test Site.

One gallon samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, for radionuclide analysis. It is estimated that these samples represent 2,000 gallon lots. The concentration of iodine-131, barium-140, and cesium-137 and naturally occurring potassium-40 are all currently being measured when present in the milk by gamma scintillation spectroscopy. Total strontium and strontium-90 are determined following radiochemical separations, and the strontium-90 is calculated by measuring the build-up of the daughter decay product, yttrium-90 (after about a two week wait) using a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference.

Publication of the data will normally require a period of about four months after collection due to shipment, processing, decay product build-up, compilation of the data, and inclusion with other radiation data in the monthly reports.

A description of the program appears in "The Occurrence of Strontium-90, Iodine-131 and Other Radionuclides in Milk, May 1957 through April 1958," by J. E. Campbell, G. K. Murthy, A. S. Goldin, H. B. Robinson, C. P. Straub, F. J. Weber, and K. H. Lewis, American Journal of Public Health, Vol. 49, No. 2, Feb. 1959, American Public Health Association, reprinted by the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959.

Detailed technical descriptions of the methodology of analyses are listed below:

"Determination of I-131, Cs-137 and Ba-140 in Fluid Milk by Gamma Spectroscopy." By G. R. Hagee, G. R. Karches and A. S. Goldin, Public Health Service.

"A Method for the Rapid Ashing of Milk for Radionuclide Analysis," Journal of Dairy Science, 42-1288, Aug. 1959. By G. K. Murthy, J. E. Campbell.

"A Method for the Determination of Radionuclides in Milk Ash," Journal of Dairy Science, 14-1276, Aug. 1959. By G. K. Murthy, L. P. Jarnagin, and A. S. Goldin.

"A Method for the Elimination of Ashing in Strontium-90 Determination of Milk," Journal of Dairy Sciences, 43 (2) 151, Feb. 1960. By G. K. Murthy, J. E. Coakley and J. E. Campbell.

TABLE I.—PUBLIC HEALTH SERVICE DATA ON RADIOACTIVITY IN MILK

MARCH 1960

Data from one sampling point supplying the areas listed below

Radioactivity in $\mu\mu c$/liter

Area	Calcium grams/liter		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	Mar.	Yearly average	Mar.	Yearly average	Mar.	Yearly average	Mar.	Yearly average	Mar.	Yearly average	Mar.	Yearly average
			(a)	(a)	(a)				(a)	(a)		
Atlanta, Ga.	1.12	1.16	35	5	0	27	18.7	16.8	0	0	65	79
Austin, Tex.	1.14	1.11	20	3	0	12	4.8	6.0	0	0	25	40
Chicago, Ill.	1.06	1.09	0	0	0	10	10.1	9.4	0	0	40	50
Cincinnati, Ohio	1.09	1.12	0	< 1	0	13	12.5	12.7	0	0	40	45
New York, N. Y.	1.09	1.07	0	1	0	7	10.9	10.2	0	0	40	49
Overton, Nev.	1.03	1.08	0	0	0	1	3.8	3.4	0	0	15	27
Sacramento, Calif.	1.04	1.10	0	< 1	0	7	4.2	4.4	0	0	20	35
Salt Lake City, Utah	1.11	1.10	0	2	0	7	10.0	7.6	0	0	55	46
Spokane, Wash.	1.06	1.15	0	2	0	18	12.6	13.3	0	0	60	66
St. George, Utah	1.02	1.10	0	< 1	0	4	3.6	4.2	0	0	20	27
St. Louis, Mo.	1.17	1.26	0	0	0	38	20.5	22.3	0	0	45	71

(a) Zero means below detectability.

ATOMIC ENERGY COMMISSION DATA ON RADIOACTIVITY IN MILK

Routine milk monitoring is conducted at New York City, Perry, New York, and Mandan, North Dakota, with analyses performed at the Atomic Energy Commission's New York Health and Safety Laboratory. Data for these three locations for the months of January, February and March, 1960 are presented below. Data for previous months were given in HASL-Reports; the most recent being listed below* and Radiological Health Data, April, May, and June, 1960.** A list of publications for previous data may be found in Radiological Health Data, April 1960.

TABLE II.—STRONTIUM-90 AND CALCIUM IN JANUARY, FEBRUARY, AND MARCH, 1960 MILK

Health and Safety Laboratory (HASL) Sampling Locations

Sampling station location	Strontium-90			Calcium	
	µµc/l. (fluid)	µµc/kg. (powder)	µµc/ gm Ca.	gm/l. (fluid)	gm/kg. (powder)
Perry, N. Y. (Powdered milk)					
January		76.0	8.6		8.8
February		63.8	7.4		8.7
March		64.8	7.3		8.9
New York City (Liquid milk)					
January	9.3		8.1	1.2	
February	9.4		8.9	1.1	
March	9.5		9.1	1.1	
Mandan, N. Dak. (Powdered buttermilk)					
January		234	22.6		10.3
February		236	21.8		10.8
March		238	22.5		10.6

---

*Health and Safety Laboratory Fallout Program Quarterly Summary Report, April 1960, available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., for $3.50.

**U. S. Department of Health, Education, and Welfare Publications available from the Office of Technical Services, Department of Commerce, Washington 25, D. C. Price 50 cents single issue.

SECTION II

AIR

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

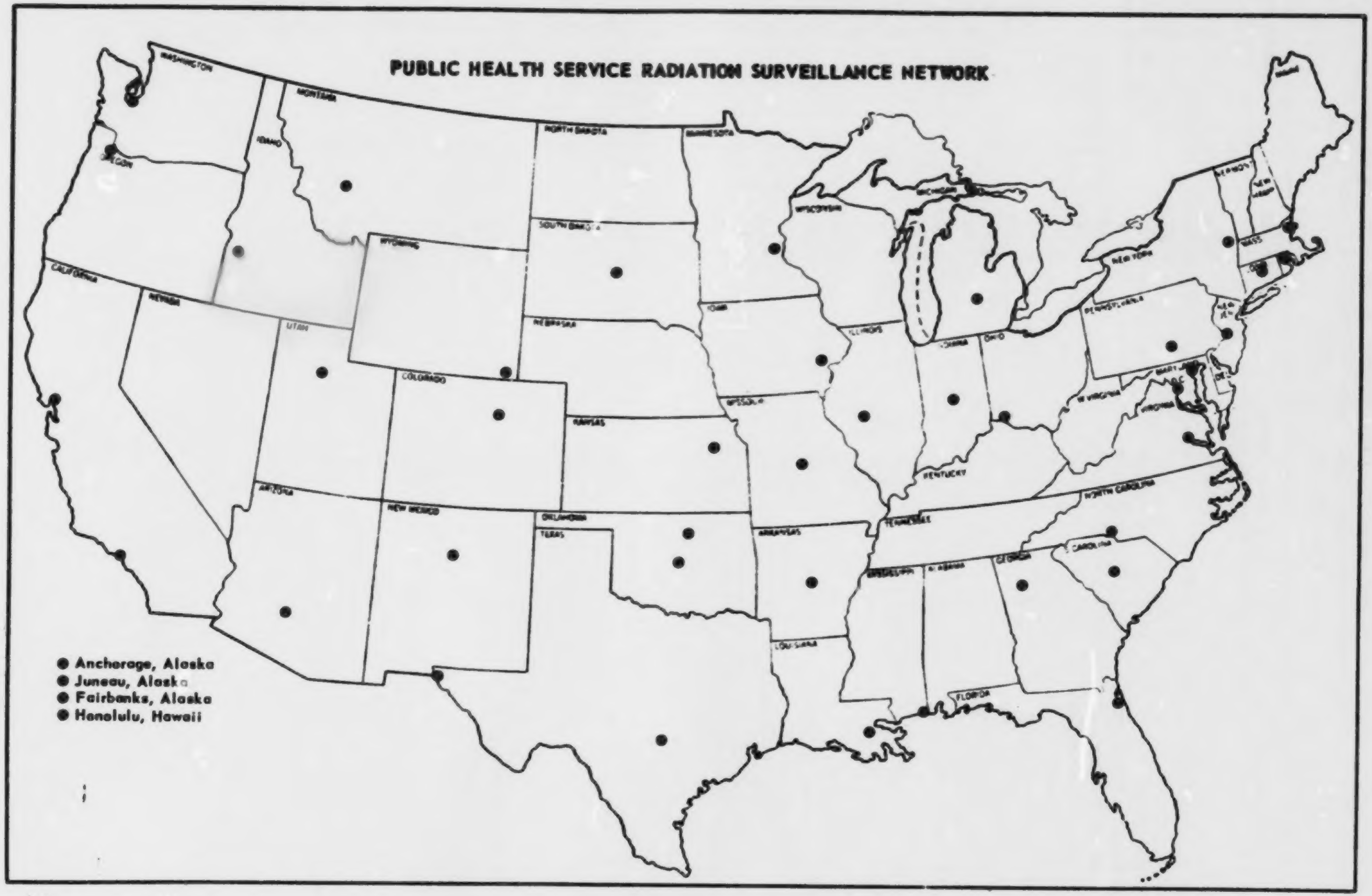
The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in environmental radiation due to radioactive fallout during nuclear weapons tests. The program has proven sufficiently valuable that it has been extended to a round-the-year basis and currently consists of 44 stations at urban locations (see figure 1) operated by State and local health department personnel with 2 operated by U. S. Public Health Service personnel.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment, and thus act as an "alert" system. These data alone are not conducive to evaluation directly of biological hazards. However, field measurements do enable the operator to estimate the amount of beta activity of particulates in the air at the station five hours after collection, by comparison to a known source, using a portable survey meter. The filters are then forwarded to the laboratory in Washington for a more refined measurement using a thin window proportional counter.

Air samplers are in operation at the 44 stations on an average of 70% of the week. Air is drawn through a cellulose carbon loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small dust-like particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

About 85% of the stations collect samples of precipitation which are sent to Washington for analysis. Values are now below limits of detection by present instrumentation. New equipment is being procured to measure lower values. Measurements have indicated that the bulk of deposited activity occurs through precipitation but concentrations in surface air are not directly relatable to the amount deposited through precipitation.

Table III presents a summary of the latest monthly data.



PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

● Anchorage, Alaska
● Juneau, Alaska
● Fairbanks, Alaska
● Honolulu, Hawaii
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
VIRGINIA
W. VIRGINIA
MARYLAND
PENNSYLVANIA
NEW YORK
VERMONT
NEW HAMP.
MAINE
MASS.
N.J.
DEL.

FIGURE 1

TABLE III.—PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Radioactivity of Particulates in Air
Micromicrocuries Per Cubic Meter—Gross Beta Counts
For month of March 1960

Station location	Weighted average	Maximum	Minimum
Alaska, Anchorage	< 0.16	0.27	< 0.10
Alaska, Fairbanks	< 0.14	0.24	< 0.10
Alaska, Juneau	< 0.12	0.20	< 0.10
Arizona, Phoenix	0.48	1.13	< 0.25
Arkansas, Little Rock	< 0.15	0.28	< 0.10
California, Berkeley	< 0.17	0.48	< 0.10
California, Los Angeles	< 0.26	0.81	< 0.10
Colorado, Denver	< 0.29	0.70	< 0.10
Connecticut, Hartford	< 0.13	0.22	< 0.10
District of Columbia	< 0.20	0.46	< 0.10
Florida, Jacksonville	< 0.23	0.34	< 0.10
Georgia, Atlanta	< 0.22	0.43	< 0.10
Hawaii, Honolulu	< 0.30	1.00	< 0.10
Idaho, Boise	0.42	0.69	0.16
Illinois, Springfield	0.21	0.41	< 0.12
Indiana, Indianapolis	< 0.15	0.25	< 0.10
Iowa, Iowa City	< 0.14	0.20	< 0.10
Kansas, Topeka	< 0.16	0.28	< 0.10
Louisiana, New Orleans	0.24	0.26	0.20
Maryland, Baltimore	< 0.18	0.30	< 0.10
Massachusetts, Lawrence	< 0.11	0.15	< 0.10
Michigan, Lansing	< 0.16	0.23	< 0.10
Minnesota, Minneapolis	< 0.14	0.22	< 0.10
Mississippi, Pascagoula	0.36	0.62	< 0.20
Missouri, Jefferson City	< 0.15	0.21	< 0.10
Montana, Helena	< 0.20	0.47	< 0.10
New Jersey, Trenton	< 0.17	0.43	< 0.10
New Mexico, Santa Fe	< 0.35	0.90	< 0.10
New York, Albany	< 0.12	0.19	< 0.10
North Carolina, Gastonia	< 0.28	0.54	< 0.10
Ohio, Cincinnati	0.27	1.40	0.10
Oklahoma, Oklahoma City	< 0.18	0.36	< 0.10
Oklahoma, Ponca City	< 0.10	0.17	< 0.10
Oregon, Portland	< 0.22	0.50	< 0.10
Pennsylvania, Harrisburg	< 0.18	0.29	< 0.10
Rhode Island, Providence	< 0.14	0.22	< 0.10
South Carolina, Columbia	< 0.20	0.30	< 0.10
South Dakota, Pierre	< 0.18	0.32	< 0.10
Texas, Austin	< 0.18	0.28	< 0.10
Texas, El Paso	0.67	1.46	0.16
Utah, Salt Lake City	0.29	0.54	< 0.10
Virginia, Richmond	< 0.14	0.20	< 0.10
Washington, Seattle	< 0.16	0.27	< 0.10
Wyoming, Cheyenne	< 0.21	0.35	< 0.10

127<

TABLE IV.—RADON AND THORON AIR MEASUREMENTS

March 1, 1960, through March 31, 1960
Cincinnati, Ohio

RADIATION SURVEILLANCE NETWORK

(Beta activity included)

Date	Continuous sample collection			Beta (a) activity $\mu\mu c/M^3$	Radon (b) AM $\mu\mu c/M^3$	Radon (c) PM $\mu\mu c/M^3$	Thoron (d) $\mu\mu c/M^3$
	Sample change time	Sampling period (hours)	Volume M^3				
Mar. 1	0806	23.9	27.2	0.4	210	100	0.3
2	0804	23.9	28.5	0.2	179	99	0.5
3	0812	24.0	28.4	0.1	102	46	0.6
4	0810	23.9	28.1	0.2(3)	79	93	0.2
7	0810	71.9	85.6	0.2	98	146	0.3
8	0809	23.9	27.0	0.5	511	70	0.5
9	0812	24.0	26.5	0.1	86	36	0.2
10	0820	23.9	27.4	0.0	142	86	0.1
11	0815	23.8	23.9	0.2(3)	114	89	0.3
14	0821	72.0	82.1	0.1	425	72	0.9
15	0810	23.7	27.6	0.2	153	84	0.2
16	0800	23.7	28.4	0.2	113	74	0.3
17	0800	23.8	28.4	0.2	91	56	0.2
18	0810	24.0	27.9	0.1(3)	73	37	0.2
21	0810	71.8	85.7	0.2	60	38	0.3
22	0815	23.9	28.5	0.3	52	32	0.2
23	0806	23.8	27.8	0.2	37	39	0.5
24	0808	23.9	28.0	0.2	86	75	0.4
25	0810	24.0	28.1	0.1(3)	41	111	0.4
28	0808	71.9	82.0	0.5	259	54	3.5
29	0806	23.9	27.1	1.4	234	92	3.8
30	0808	23.9	28.0	0.5	67	92	1.3
31	0806	23.9	28.2	0.2	123	54	0.7
	Average....................................			0.26	145	72	0.6

(a) Gross beta activity when counted one day after end of sampling or later as indicated by numeral in parenthesis.

(b) Measured within a few minutes of removal of filter from sampler and corrected back to collection time (uncorrected for thoron daughter interference).

(c) Filters are temporarily withdrawn from sampler at about 3 p.m. and counted. (Values are corrected back to removal time.) The filters are then replaced on sampler to complete the sampling period of about 24 hours. Thus, the values in this column are from the same filters that are counted at about 8 a.m. the following day.

(d) Thoron from alpha activity of filter sample counted 7 hours after taking a 24-96 hour sample.

U. S. NAVAL RESEARCH LABORATORY

Data on Radioactivity in Air

Radioactivity measurements of air-filter samples collected at various sites along the 80th Meridian (West) are made by the U. S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during April 1960 is shown in Table V, while the [illegible] radioactivity profile for the same month is shown in Figure 2. All radioactivity concentrations are given in disintegrations per minute per cubic meter of air at the collecting site. (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter.)

TABLE V.—U. S. NAVAL RESEARCH LABORATORY DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION

April 1960

Day	Disintegrations/minute per cubic meter of air						
	Punta Arenas	Puerto Montt	Santiago	Antofagasta	Chacaltaya	Lima	Guayaquil
1	0.07	-	0.17	0.13	0.03	0.03	0.09
2	0.04	0.08	0.05	0.08	0.03	0.02	0.07
3	0.04	0.08	0.05	0.08	0.03	0.02	0.07
4	0.04	0.08	0.05	0.08	0.03	0.02	0.07
5	-	0.02	0.12	0.08	0.04	0.05	0.07
6	-	0.02	0.12	0.08	0.04	0.05	0.05
7	-	0.06	0.05	0.08	0.08	0.05	0.02
8	0.02	0.06	0.05	0.08	0.08	0.05	0.12
9	0.02	0.07	0.12	0.09	0.03	0.03	0.07
10	0.02	0.07	0.12	0.09	0.03	0.03	0.07
11	0.02	0.07	0.12	0.09	0.03	0.03	0.07
12	0.01	0.05	0.12	0.11	0.04	0.07	0.07
13	0.01	0.05	0.12	0.11	0.04	0.07	0.07
14	0.03	0.05	0.10	0.07	0.01	0.03	0.07
15	0.03	0.05	0.10	0.07	0.01	0.03	0.06
16	0.03	0.05	0.08	0.07	0.02	0.03	0.06
17	0.03	0.05	0.08	0.07	0.02	0.03	0.05
18	0.03	0.05	0.08	0.07	0.02	0.03	0.05
19	0.02	0.02	0.10	0.07	0.03	0.03	0.07
20	0.02	0.02	0.10	0.07	0.03	0.03	0.07
21	-	0.03	0.05	0.09	0.03	0.05	0.06
22	-	0.03	0.05	0.09	0.03	0.05	0.06
23	-	0.06	0.08	0.06	0.06	0.03	0.07
24	-	0.06	0.08	0.06	0.06	0.03	0.07
25	-	0.06	0.08	0.06	0.06	0.03	0.07
26	-	0.08	0.12	0.07	0.05	0.05	0.07
27	-	0.08	0.12	0.07	0.05	0.05	0.07
28	-	0.02	0.09	0.08	0.03	0.03	0.07
29	-	0.02	0.09	0.08	0.03	0.03	0.07
30	-	0.05	-	0.05	0.03	0.03	0.07
Mean value	0.03	0.05	0.09	0.08	0.04	0.04	0.07

129<-

TABLE V.—U. S. NAVAL RESEARCH LABORATORY DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION—Con.

April 1960

Day	Disintegrations/minute per cubic meter of air							
	Mira-flores	San Juan	Mauna Loa	Miami	Wash-ington	Moosonee	Thule	Bravo*
1	0.13	0.12	0.27	0.43	0.91	0.44	0.31	0.26
2	0.11	0.28	0.30	0.28	0.08	0.39	0.43	0.26
3	0.11	0.28	0.30	0.28	0.08	0.35	0.43	0.26
4	0.11	0.28	0.30	0.28	0.08	0.16	0.43	0.26
5	0.12	0.64	0.31	0.25	0.25	0.44	0.44	0.15
6	0.12	0.64	0.31	0.85	0.25	0.51	0.44	0.15
7	0.24	0.64	0.24	0.74	0.60	0.58	0.45	0.15
8	0.24	0.64	0.24	0.74	0.60	0.60	0.45	0.15
9	0.23	0.48	0.18	0.63	0.38	0.53	0.35	0.15
10	0.23	0.48	0.18	0.63	0.38	0.53	0.35	0.15
11	0.23	0.21	0.18	0.63	0.38	0.71	0.35	0.31
12	0.31	0.21	0.24	0.77	0.71	0.30	0.31	0.31
13	0.31	0.21	0.24	0.77	0.71	0.55	0.31	0.31
14	0.46	0.21	0.17	0.83	0.77	0.53	0.29	0.31
15	0.46	0.21	0.17	0.83	0.77	0.30	0.29	0.31
16	0.22	0.45	0.16	0.81	0.74	0.37	0.25	0.31
17	0.22	0.45	0.16	0.81	0.74	0.37	0.25	0.31
18	0.22	0.45	0.16	0.81	0.74	0.39	0.25	0.31
19	0.37	0.35	0.29	0.60	0.45	0.48	0.33	0.29
20	0.37	0.35	0.29	0.60	0.45	0.41	0.33	0.29
21	0.31	0.35	0.46	0.55	0.83	0.44	0.38	0.29
22	0.31	0.35	0.46	0.55	0.83	0.41	0.38	0.29
23	0.22	0.19	0.39	0.41	0.79	0.21	0.38	0.29
24	0.22	0.19	0.39	0.41	0.79	0.21	0.38	-
25	0.22	0.19	0.39	0.41	0.79	0.32	0.33	-
26	0.08	0.19	0.27	0.23	0.52	0.21	0.33	-
27	0.08	0.19	0.27	0.23	0.52	0.39	0.33	-
28	0.11	0.15	-	0.36	0.25	0.32	0.31	-
29	0.11	0.15	-	0.36	0.25	0.55	0.31	-
30	0.05	0.13	-	0.39	0.39	0.37	0.31	-
Mean value	0.22	0.32	0.27	0.55	0.53	0.41	0.35	0.26

* Arctic Ice Floe Station "Bravo."

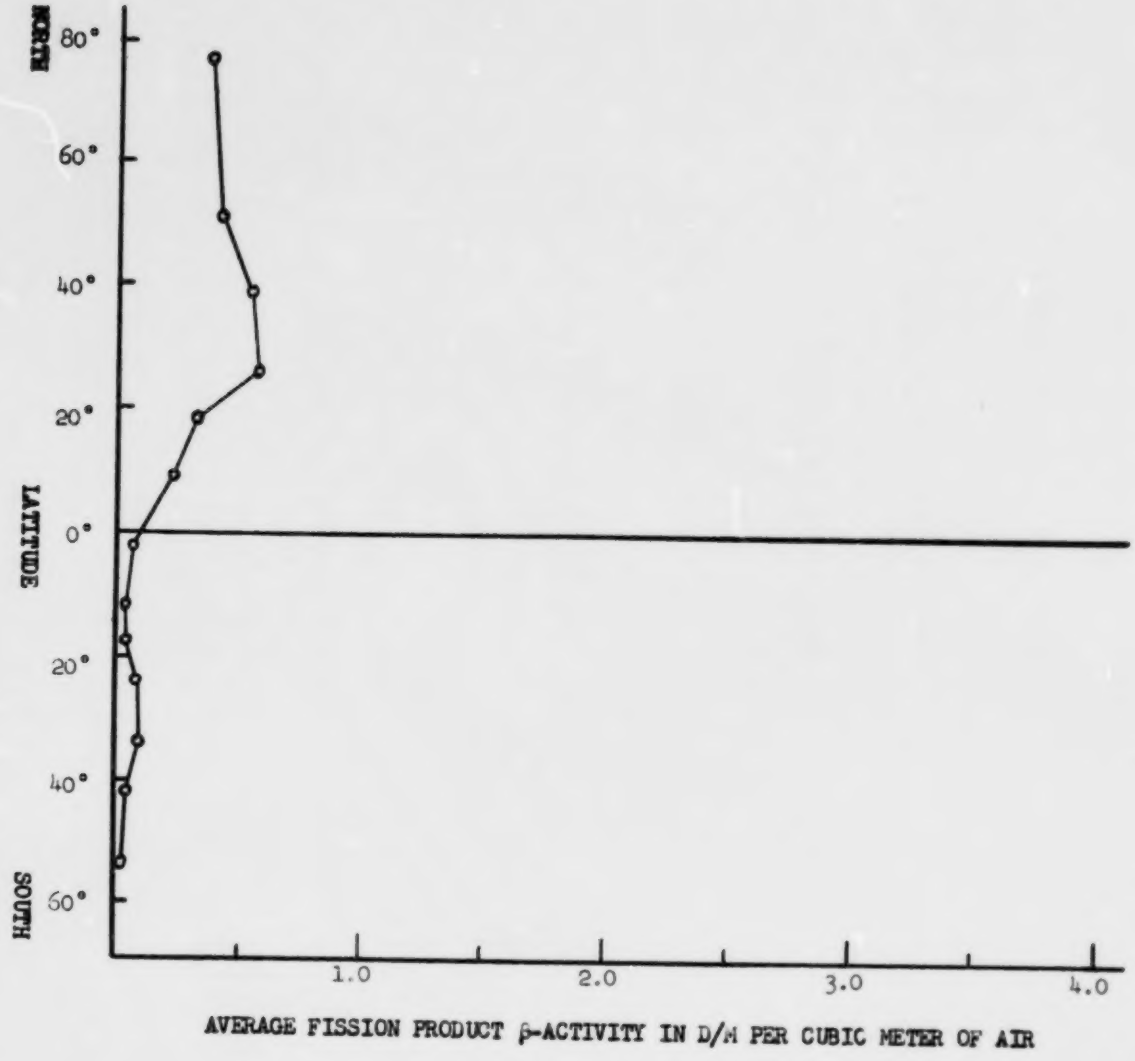
130<

FIGURE 2

Average Measurements of Surface Air at 13 Stations Along 80th Meridian

April 1960

U. S. NAVAL RESEARCH LABORATORY



131<

TABLE VI.—DATA ON RADIOACTIVITY IN THE AIR AT LEMONT, ILLINOIS

Argonne National Laboratory—Atomic Energy Commission

Air filter measurements of ground level air at Argonne National Laboratory for September 1959 to March 1960 have been reported to the Atomic Energy Commission by Dr. Philip F. Gustafson. In the table below, activity is expressed in micromicrocuries per 100 cubic meters of air.

Isotope	1959				1960		
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March
Zr^{95}-Nb^{95}	0.77	0.28	0.22	0.12	0.11	0.07	0.05
Cs^{137}	0.34	0.23	0.20	0.18	0.30	0.23	0.21
Ru^{106}	1.28	0.77	0.60	0.35	0.45	0.30	0.15
Ce^{144}	3.28	2.07	2.05	1.49	1.61	1.93	1.80
Rh^{102}(1)	0.4	0.7	1.6	2.0	2.3	3.6	4.1
W^{185}(2)	99	39	92	56	40	60	63

(1) Corrected for decay back to mid-August 1958. This isotope first appeared in ground level air in September 1959.

(2) Corrected for decay back to mid-June 1958.

132<

SECTION III

WATER

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK

The National Water Quality Network was established under the provisions of Section 4(c) of Public Law 660, which states that ". . . the Surgeon General shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local health agencies, was started in October 1957. There are 75 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses; some of these stations are interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately a total of 250 to 300 stations will be operated. A few of the more recently established stations have not yet begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some continuous composite samples of 10 to 15 days are obtained. Radioactivity determinations are made on single samples, taken weekly.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The radioactivity levels of dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. The results are reported in micromicrocuries per liter, and are shown for each station on a given river.

While beta determinations for the first two years of the Network operation have been done on each sample weekly, the alpha determinations are reported generally on a composite sample of more than 1 week. Beginning with samples taken in January 1960, beta determinations are to be performed on composite samples obtained by combining two weekly samples. The alpha data will be reported on three-month composite samples, with 1/3 of the stations being covered each month. All the data reported below represent the average of all information available for the month indicated.

Strontium-90 data are reported as being the results of determinations on composite sample for a three-month period ending in the month shown.

Additional information and data may be obtained from the following sources:

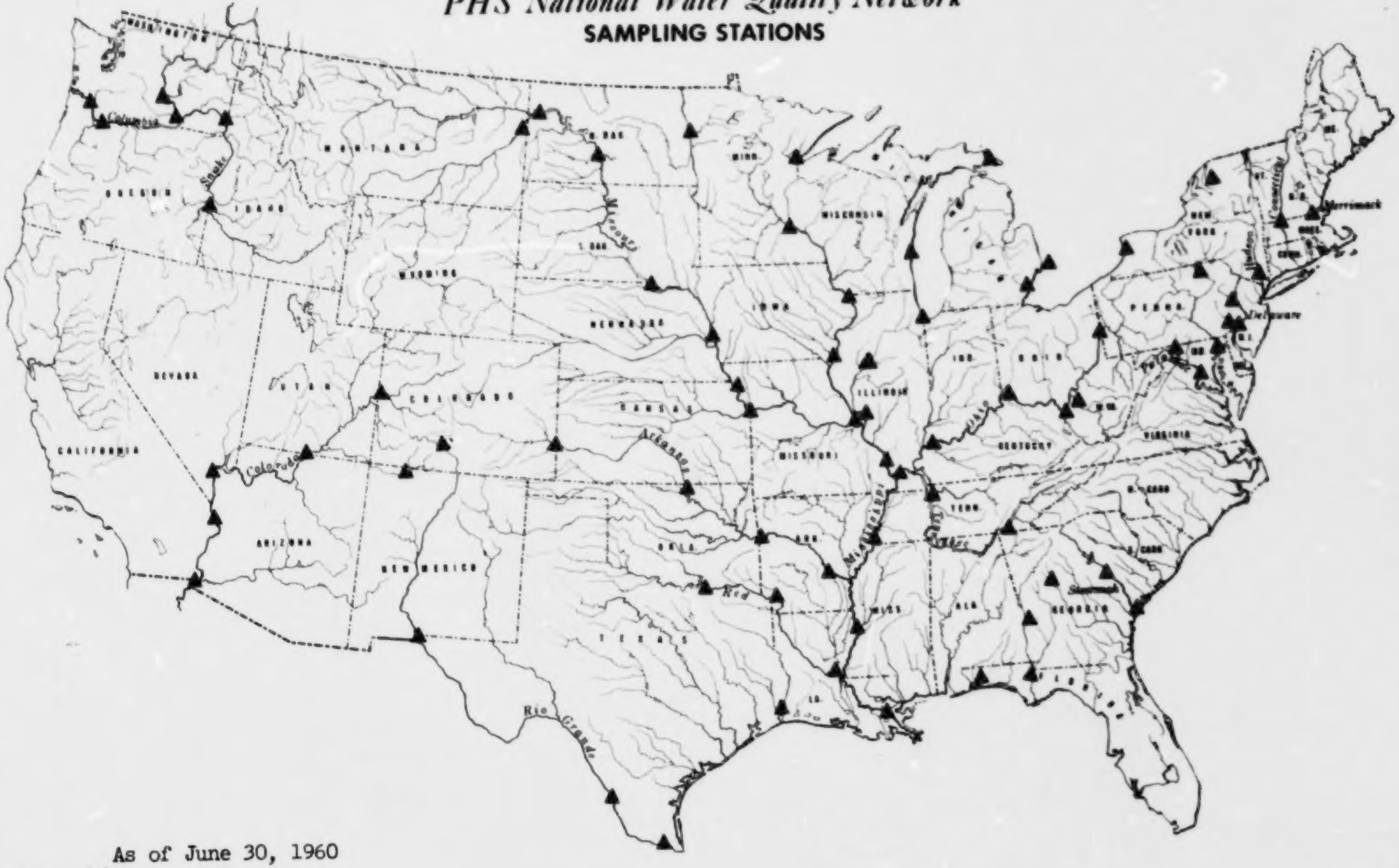
1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.50.

2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, to Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, Pages 167-169.

133<

FIGURE 3

PHS National Water Quality Network
SAMPLING STATIONS


WASHINGTON
Columbia
Snake
OREGON
IDAHO
MONTANA
NEVADA
CALIFORNIA
UTAH
WYOMING
COLORADO
Colorado
ARIZONA
NEW MEXICO
Rio Grande
N. DAK
S. DAK
Missouri
NEBRASKA
KANSAS
Arkansas
OKLA
TEXAS
Red
MINN
IOWA
MISSOURI
WISCONSIN
ILLINOIS
Mississippi
ARK
LA
MISS
IND
OHIO
Ohio
KENTUCKY
TENN
Tennessee
ALA
GEORGIA
Savannah
FLORIDA
S. CARO
N. CARO
VIRGINIA
W. VA
Potomac
PENNA
Delaware
NEW YORK
Hudson
Connecticut
Merrimack
ME

As of June 30, 1960

TABLE VII.—U. S. PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK RADIOACTIVITY IN RAW SURFACE WATERS

(Micromicrocuries per liter)

Station	Quarter ending 12/31/59	Month of February 1960 (Average to nearest whole number)					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Dis.	Tot.	Susp.	Dis.	Tot.
ALSEA RIVER							
Alsea, Oreg.	0.2	0	0	0	0	0	0
ANIMAS RIVER							
Cedar Hill, N. Mex.	-	72	59	131	28	24	52
ARKANSAS RIVER							
Coolidge, Kans.	0.4	0	44	44	0	58	58
Ponca City, Okla.	0.6	12	5	17	0	0	0
Fort Smith, Ark.	1.2	-	-	-	-	-	-
Pendleton Ferry, Ark.	0.6	48	6	54	4	0	4
CHATTAHOOCHIE RIVER							
Columbus, Ga.	0.2	2	0	2	0	5	5
COLORADO RIVER							
Loma, Colo.	0.3	8	2	10	8	8	16
Page, Ariz.	0.3	64	12	76	30	8	38
Hoover Dam, Ariz.-Nev.	0.7	0	16	16	<1	6	6
Parker Dam, Ariz.-Calif.	0.7	6	12	18	<1	6	6
Yuma, Ariz.	0.6	4	5	9	0	6	6
COLUMBIA RIVER							
Wenatchee, Wash.	0.8	1	3	4	0	0	0
Pasco, Wash.	0.9	106	411	517	0	0	0
Bonneville Dam, Oreg.	1.0	76	162	238	0	0	0
Clatskanie, Oreg.	0.5	15	66	81	0	<1	0
CONNECTICUT RIVER							
Northfield, Mass.	0.3	0	1	1	0	0	0
DELAWARE RIVER							
Martin's Creek, Pa.	-	1	2	3	0	0	0
Philadelphia, Pa.	0.6	3	4	7	0	1	1
GREAT LAKES							
Gary, Ind.	0.4	0	6	6	0	1	1
Duluth, Minn.	0.3	0	0	0	0	0	0
Detroit, Mich.	0.7	0	0	0	0	0	0
Buffalo, N. Y.	1.1	0	0	0	0	0	0
HUDSON RIVER							
Poughkeepsie, N. Y.	1.3	0	1	1	1	1	2
KANAWHA RIVER							
Winfield Dam, W. Va.	-	0	0	0	0	0	0
MERRIMACK RIVER							
Lowell, Mass.	0.5	0	0	0	1	1	2
MISSISSIPPI RIVER							
Red Wing, Minn.	0.7	0	16	16	0	2	2
Dubuque, Iowa	1.4	1	3	4	0	1	1
Burlington, Iowa	1.0	0	2	2	1	1	2
East St. Louis, Ill.	0.5	1	0	1	1	2	3
Cape Girardeau, Mo.	0.4	4	5	9	6	2	8

135<

TABLE VII.—U. S. PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK RADIOACTIVITY IN RAW SURFACE WATERS— Con.

(Micromicrocuries per liter)

Station	Quarter ending 12/31/59	Month of February 1960 (Average to nearest whole number)					
		Beta activity			Alpha activity		
	Strontium-90	Susp.	Dis.	Tot.	Susp.	Dis.	Tot.
MISSISSIPPI—Con.							
W. Memphis, Ark.	1.3	17	24	41	3	0	3
Delta, La.	1.0	13	6	19	6	1	7
New Orleans, La.	0.9	16	8	24	7	1	8
MISSOURI RIVER							
Williston, N. Dak.	0.5	-	-	-	-	-	-
Bismarck, N. Dak.,	0.9	2	2	4	0	5	5
Yankton, S. Dak.	0.5	0	6	6	0	1	1
Omaha, Nebr.	1.0	2	8	10	1	3	4
St. Joseph, Mo.	0.4	2	4	6	0	5	5
Kansas City, Kans.	0.7	6	6	12	0	4	4
St. Louis, Mo.	0.6	18	11	29	6	2	8
OHIO RIVER							
East Liverpool, Ohio	0.6	0	0	0	1	0	1
Huntington, W. Va.	0.2	16	11	27	1	0	1
Cincinnati, Ohio	0.8	10	0	10	4	0	4
Evansville, Ind.	-	11	2	13	2	< 1	3
Cairo, Ill.	1.2	6	0	6	1	0	1
POTOMAC RIVER							
Williamsport, Md.	0.5	0	0	0	0	0	0
Great Falls, Md.	0.4	<1	0	<1	0	0	0
RED RIVER							
Denison, Tex.	1.9	0	0	0	0	0	0
Index, Ark.	0.9	2	5	7	2	2	4
Alexandria, La.	1.6	14	1	15	3	1	4
RIO GRANDE RIVER							
Laredo, Tex.	0.7	4	10	14	0	3	3
Brownsville, Tex.	0.3	0	117	117	1	0	1
ST. MARY'S RIVER							
Sault Ste. Marie, Mich.	0.3	0	1	1	0	0	0
SCHUYLKILL RIVER							
Philadelphia, Pa.	-	0	< 1	< 1	0	< 1	< 1
SAVANNAH RIVER							
North Augusta, S. C.	0.7	-	-	-	-	-	-
Port Wentworth, Ga.	0.7	1	4	5	0	0	0
SNAKE RIVER							
Wawawai, Wash.	0.4	< 1	0	< 1	0	1	1
TENNESSEE RIVER							
Chattanooga, Tenn.	1.1	3	87	90	0	0	0
YELLOWSTONE RIVER							
Sidney, Mont.	0.7	0	< 1	< 1	0	1	1

STRONTIUM-90 IN TAP WATER

HEALTH AND SAFETY LABORATORY—ATOMIC ENERGY COMMISSION

Tap water for Richmond, California and New York City is monitored for strontium-90 on a monthly basis by the Atomic Energy Commission's New York Health and Safety Laboratory. The strontium-90 in tap water for the months December 1959 through March 1960 is presented below. Data for other months in 1959 were given in HASL-84, page 99.*

TABLE VIII.—STRONTIUM-90 IN TAP WATER

Richmond, California

(Approximately 40 liters per sample)

Month	$\mu\mu c$ Sr^{90}/liter	Sr^{89}/Sr^{90} at mid-point of sampling month
December 1959	0.313	0.48
January 1960	0.296	0.54
February	0.273	0.44
March	0.284	0.28

New York City

(100-200 liters per sample)

Month	$\mu\mu c$ Sr^{90}/liter	Sr^{89}/Sr^{90} at mid-point of sampling month
December 1959	0.62	0.7
January 1960	0.70	0.4
February	0.60	0.2
March	0.60	-

---

*Health and Safety Laboratory Fallout Program Quarterly Summary Report, April 1, 1960, available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., for $3.50.

137<

SECTION IV

OTHER DATA

EXTERNAL GAMMA ACTIVITY
PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Portable survey instruments are available at the stations of the Radiation Surveillance Network and one of their uses is to record external gamma radiation. These readings are not precise, especially for measurement of low levels but they can show the presence or absence of any significant increases above background. The differences among the values shown on the following table are within the variances anticipated due to differences in normal background and in instrument response characteristics.

TABLE IX.—EXTERNAL GAMMA ACTIVITY
PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Milliroentgens per hour—at three feet above the ground
For month of March 1960

Station location	Average	Station location	Average
Alaska, Anchorage	0.01	Minnesota, Minneapolis	0.01
Alaska, Fairbanks	0.01	Mississippi, Pascagoula	(*)
Alaska, Juneau	0.02	Missouri, Jefferson City	0.01
Arizona, Phoenix	0.02	Montana, Helena	0.03
Arkansas, Little Rock	0.02	New Jersey, Trenton	0.02
California, Berkeley	(*)	New Mexico, Santa Fe	0.04
California, Los Angeles	0.01	New York, Albany	0.02
Colorado, Denver	0.02	North Carolina, Gastonia	0.02
Connecticut, Hartford	0.01	Ohio, Cincinnati	(*)
District of Columbia	0.02	Oklahoma, Oklahoma City	0.02
Florida, Jacksonville	0.02	Oklahoma, Ponca City	0.04
Georgia, Atlanta	0.02	Oregon, Portland	0.02
Hawaii, Honolulu	0.02	Pennsylvania, Harrisburg	(*)
Idaho, Boise	(*)	Rhode Island, Providence	0.01
Illinois, Springfield	(*)	South Carolina, Columbia	0.02
Indiana, Indianapolis	0.01	South Dakota, Pierre	0.02
Iowa, Iowa City	0.01	Texas, Austin	0.01
Kansas, Topeka	0.02	Texas, El Paso	0.02
Louisiana, New Orleans	0.01	Utah, Salt Lake City	0.02
Maryland, Baltimore	0.02	Virginia, Richmond	0.01
Massachusetts, Lawrence	0.02	Washington, Seattle	0.02
Michigan, Lansing	0.02	Wyoming, Cheyenne	0.02

*No data received.

MEDICINE

The following article, "Radioisotopes in Medicine" appeared in the May-June 1960 issue of Research for Industry (the publication of Stanford Research Institute, Menlo Park, California). It deals with a major area of radiological health and is reproduced here by permission of Stanford Research Institute. In future issues of Radiological Health Data it is planned to include additional materials on this subject and on the fields of X-rays, as applicable to radiological Health. Contributions are most welcome.

Radioisotopes in Medicine

On August 2, 1946, the first shipment of radioisotopes for medical purposes was made by the Atomic Energy Commission. Fourteen years later, just what has been the effect of these new substances on the practice of medicine? How often and in what ways have they been used? Where? By whom? And what are the indications for future use?

The Office of Isotopes Development of the AEC sponsored a search for answers to these and other questions regarding medical usage of radioisotopes. The investigation, conducted by nuclear industrial economist Richard R. Tarrice and senior health economist Mark S. Blumberg, M.D., lasted one year and took the project team into hospitals, clinics, laboratories, and physicians' offices across the nation.

Growing Usage

In general, they found that the use of radioisotopes in medicine has become widespread. About 400,000 administrations are given to humans annually; 85 percent of these are for diagnosis. Twenty different isotopes are used, with radioiodine being by far the most common. Others commonly used include radiophosphorous, cobalt 60, and chromium 51.

An average of three out of every 1000 patients in clinics or hospitals undergo some type of diagnosis or therapy involving radioisotopes. This is about the same number as those who have fractures, appendectomies, or hernia repair. The number is more obviously significant when one considers that radioisotopes are chiefly used for relatively infrequent conditions—endocrine disorders and cancer.

Over 1,000 general hospitals in the United States offer radioisotope services, and they are also used in clinics and physicians' offices. At present over 40 percent of hospitalized persons are in institutions offering these services.

These numbers should grow. A fairly comprehensive clinical radioisotope program can be equipped for $7,000 to $10,000, which is within the range of most institutions that could make practical use of a program. Therefore, the number of institutions using radioisotopes may well triple by 1965. Further, the number of physicians trained to use these still-new tools could increase as much as fivefold in the next ten years.

The study also considered cobalt 60 teletherapy units. It was found that such units or supervoltage X-ray units are located in medical service areas that contain two-thirds of the radiation specialists and over half the population. Projections on the number of units likely to be used in the future were made on the basis of cancer and population trends.

Research and Future Uses

About 300 institutions are carrying on medical research with radioisotopes. Some 2,000 separate projects, using well over 100 different isotopes, are in progress. This represents over ten percent of all health research projects in the United States supported by the federal government or national foundations.

The coming trends in radioisotopes cannot be predicted with precision because (1) there are no historical trends to analyze, and (2) any of a number of possible future applications could grow to exceed all current uses. However, the project team noted that the volume in the United States of current uses alone could grow to 700,000 administrations a year, if urban use-rate of isotopes were to become standard for the nation as a whole. Research in the field should also increase, leading to new uses.

Current health research investigations show potential applications in conditions far more frequently encountered than those providing bases for current applications. For example, studies of insulin metabolism using radioisotope-tagged insulin may provide important clinical data on diabetes. In vitro tests with radioisotopes are being studied for determining immunity to various contagious diseases, and these might find wide application for children. Or, another example, tests with radioisotopes may contribute to diagnosis of certain mental illnesses associated with metabolic disorders.

If only one of these were to find acceptance, considerably more than 700,000 annual administrations might well be expected in coming years.

139

SOILS

Summary Statements on Environmental Sampling Programs

As a service to those concerned directly with the many radiation environmental sampling programs, summary statements will be published showing the organization of these programs as soon as they are completed. The fourth of these statements dealing with soil programs follows. The compilation does not purport to be complete, but does encompass most of the major efforts.

These programs are flexible in the number and location of stations, scope, duration, purpose and frequency of sampling and were designed to obtain information concerning the mechanisms of radioactive fallout rather than for environmental monitoring purposes.

Those in charge of any regularly conducted environmental sampling programs are encouraged to report both the organizational and administrative aspects of their programs, and the data derived therefrom, for possible inclusion in these monthly reports.

140<

TABLE X.—A SELECTED LIST OF ENVIRONMENTAL

Type of sample	Operating agency	Sponsoring agency	Where sampled	Number of stations	Frequency of sampling	Year estab-lished
A. Soil	HASL, AEC	AEC	U.S.	17	Yearly through 1958	1955
B. Soil	USDA	AEC	Worldwide	87	Every 1-2 years	1956
C. Soil	USDA	AEC	Mid U.S. 32" annual rainfall sites	18	(1 year only)	1958
D. Soil	Argonne National Laboratory	AEC	Lemont, Ill. ANL	1	Monthly	1957
E. Soil	HASL-USDA Pasture site program	AEC	U.S.	6	Yearly	1953
F. Soil	USDA Chicago Milk-shed Area Survey	AEC	Chicago Milkshed Area	6	Yearly through 1958	1955
G. Soil	HASL-USDA	AEC	U.S.	62	Yearly	1959
H. Soil	HASL-USDA	AEC	West Coast U.S.	16	Yearly	1957

141<

SAMPLING NETWORKS FOR ANALYSIS OF RADIOACTIVITY IN SOILS

Principal in charge	Radioactivity analysis				Supplementary analysis
	Gross radiation	Fission products	Tracers	Natural activity	
Dr. John Harley	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. P. F. Gustafson	-	Cs-137 Ru-106 Ru-103 Ce-141 Ce-144 Zr-95 Nb-95	-	Uranium, thorium and K-40	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-
Dr. Lyle Alexander	-	Sr-90	-	-	-

142<

SOIL NETWORKS—METHODS OF PUBLICATION OF DATA

A. Health and Safety Laboratory (AEC)—Soil.

HASL-42 "Environmental Contamination From Weapons Tests," Oct 1958.

HASL-55 AEC "Strontium Program, Quarterly Summary Report," Feb. 2, 1959.

HASL-65 AEC "Strontium Program, Quarterly Summary Report," May 29, 1959.

HASL-69 AEC "Strontium Program, Quarterly Summary Report," Oct. 1, 1959.

HASL-77 AEC "Strontium Program, Quarterly Summary Report," Jan. 1, 1960.

HASL-84 AEC "Fallout Program, Quarterly Summary Report," April 1960. AEC Quarterly Statements on Fallout.

"Measurement of Strontium-90 in Geophysical and Biological Materials." Eisenbud, M. Statement to Joint Committee on Atomic Energy Hearings on Fallout, May 1957. Vol. 1, p. 554.

"Summary of Analytical Results from the HASL Strontium Program July Through December, 1956." Harley, J. H., Hardy, E. P. Jr., Whitney, I. B. and Eisenbud, M. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1957. Vol. 1, p. 591.

"Strontium-90 Distribution as Determined by the Analysis of Soils." Alexander, L. T. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959. Vol. 1, p. 278.

"Data on the Deposition of Strontium-90 During 1958." Harley, J. H., Hardy, E. P. Jr., Klein, S. and Lough S. A. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959. Vol. 1, p. 373.

"Deposition of Strontium-90 Through October 1958." Eisenbud, M. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959. Vol. 1, p. 907.

"Radioisotopes in Soil with Particular Emphasis on Strontium-90", L. T. Alexander, E. P. Hardy, Jr., H. L. Hollister, presented at the International Symposium on the Ecology of Radioisotopes, Radioisotopes in the Biosphere, University of Minnesota, October 19-23, 1959.

B. U. S. Department of Agriculture—Atomic Energy Commission Worldwide Soil.

HASL-42 Environmental Contamination From Weapons Tests, Oct. 1958.

HASL-55 AEC Strontium Program, Quarterly Summary Report, Feb. 2, 1959.

HASL-65 AEC Strontium Program, Quarterly Summary Report, May 29, 1959.

HASL-69 AEC Strontium Program, Quarterly Summary Report, Oct. 1, 1959.

HASL-77 AEC Strontium Program, Quarterly Summary Report, Jan. 1, 1960.

HASL-84 AEC Fallout Program, Quarterly Summary Report, April, 1960. AEC Quarterly Statements on Fallout.

Strontium-90 Distribution as Determined by the Analysis of Soils. By L. T. Alexander. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959, Vol. I, page 278.

Measurement of Strontium-90 in Geophysical and Biological Material, By M. Eisenbud. Statement to Joint Committee on Atomic Energy Hearings on Fallout, May 1957, Vol. I, page 554.

Summary of Analytical Results from the HASL Strontium Program July Through December, 1956, By J. M. Harley, E. P. Hardy, Jr., I. S. Whitney and M. Eisenbud. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1957, Vol. I, page 591.

Data on the Deposition of Strontium-90 During 1958, By J. H. Harley, E. P. Hardy, Jr., S. Klein and S. A. Lough. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959.

"Radioisotopes in Soil with Particular Emphasis on Strontium-90" L. T. Alexander, E. P. Hardy, Jr., H. L. Hollister, presented at the International Symposium on the Ecology of Radioisotopes, Radioisotopes in the Biosphere, University of Minnesota, October 19-23, 1959.

143<

C. U. S. Department of Agriculture.

(Strontium-90 Values Along a Mid-continental 32-inch Precipitation Transect)

Strontium-90 Distribution as Determined by the Analysis of Soils, by L. T. Alexander. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959, Vol. I, page 278.

HASL-65 AEC Strontium Program, Quarterly Summary Report, May 29, 1959.

"Radioisotopes in Soil with Particular Emphasis on Strontium-90" L. T. Alexander, E. P. Hardy, Jr., H. L. Hollister, presented at the International Symposium on the Ecology of Radioisotopes, Radioisotopes in the Biosphere, University of Minnesota, October 19-23, 1959.

D. Argonne National Laboratory—Atomic Energy Commission

ANL-6049, Argonne National Laboratory, Radiological Physics Division, Semiannual Report, January through June 1959, October, 1959.

ANL-5919, Argonne National Laboratory, Radiological Physics Division, Semiannual Report, January through June 1958, September 1958.

ANL-5967, Argonne National Laboratory, Radiological Physics Division, Semiannual Report, July through December 1958, May 1959.

P. F. Gustafson, "Ratio of Cesium-137 and Strontium-90 Radioactivity in Soil," Science, 130, 3386, 1404-5 (20 Nov. 1959).

Appendix to the Statement of Dr. Austin M. Brues, Hearings before the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy, May 1959, Vol. 2, page 1400.

E. U. S. Department of Agriculture—Atomic Energy Commission—Pasture Program.

Summary of Analytical Results From the HASL Strontium Program July Through December, 1956, by J. H. Harley, E. P. Hardy, Jr., I. B. Whitney and M. Eisenbud. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1957, page 591.

HASL-42 AEC Environmental Contamination from Weapons Tests, Oct., 1958.

F. Chicago Milkshed Soils (1955)

Project Sunshine Bulletin, No. 12: Strontium-90 Concentration Data for Biological Materials, Soils, Waters and Air Filters. E. A. Martell, August 1, 1956.

HASL-42 AEC Environmental Contamination from Weapons Tests, Oct., 1958.

G. U. S. Department of Agriculture—Health and Safety Laboratory (State Sites—1959)

"Strontium-90 Distribution as Determined by the Analysis of Soils," Alexander, L. T. Submitted to the Joint Committee on Atomic Energy Hearings on Fallout, May 1959, Vol. I, p. 278.

"Radioisotopes in Soil with Particular Emphasis on Strontium-90," L. T. Alexander, E. P. Hardy, Jr., H. L. Hollister, presented at the International Symposium on the Ecology of Radioisotopes, Radioisotopes in the Biosphere, University of Minnesota, October 19-23, 1959.

HASL-65 AEC "Strontium Program, Quarterly Summary Report," May 1959.

HASL-69 AEC "Strontium Program, Quarterly Summary Report," October 1959.

H. U. S. Department of Agriculture—Health and Safety Laboratory (West Coast Rainfall Study)

144<

SOIL NETWORKS—SAMPLING STATION LOCATIONS

A. Health and Safety Laboratory—Atomic Energy Commission Soil Samples

(Discontinued in 1959)

Seattle, Washington
Rapid City, South Dakota
Boise, Idaho
Rochester, New York
Detroit, Michigan
Binghamton, New York
Des Moines, Iowa
Salt Lake City, Utah
New York, New York
Philadelphia, Pennsylvania
Grand Junction, Colorado
Memphis, Tennessee
Albuquerque, New Mexico
Atlanta, Georgia
Los Angeles, California
New Orleans, Louisiana
Jacksonville, Florida

Note: This sampling program merged in 1959 with the program described under section C to obtain coverage of all the states.

B. U. S. Department of Agriculture Worldwide Soil Samples

Hawaii-Oahu, Kawailoa Girls' School
Hawaii-Oahu, Leilehua Golf Course
Hawaii-Oahu, Kahuku
Hawaii-Oahu, Wahiawa, Mauka Intake
Canton Island, near air strip
Canton Island, near lighthouse
Wake Island
Campbell Island
Bermuda—Hamilton
Japan—Tokyo
Japan—Sapporo
Japan—Fukuoka
Philippines—Manila
Singapore
India—Calcutta
Pakistan—Karachi
Aden
United Arab Republic—Damascus
Lebanon—Beirut
Turkey—Ankara
Senegal—Dakar
Senegal—Hann
Kenya—Kikuyu
Southern Rhodesia—Salisbury
Union of South Africa—Durban
Belgian Congo—Leopoldville
Italy—Florence
France—Paris
Norway—Oslo
Norway—Lake Finse
Norway—Bodo
Norway—Bergen
Norway—Bardufoss
Norway—Vadso
Norway—Ekkerow
Iceland—Reykjavik
Panama—Fort Amador, Canal Zone
Panama—Fort Clayton, Canal Zone
Venezuela—Caracas
Puerto Rico—San Juan
Colombia—Bogota
Peru—Lima
Peru—Huancayo
Chile—Santiago
Chile—Antofagasta
Chile—Punta Arenas
Argentina—Buenos Aires
Paraguay—Asuncion
Brazil—Sao Paulo
Brazil—Belem
Brazil—Belem, Institute
Australia—Adelaide
Australia—Brisbane
Australia—Katherine
Australia—Perth
Australia—Alice Springs
Tasmania—Hobart
New Zealand—South Canterbury
New Zealand—North Auckland
New Zealand—Wellington
Canada—Ottawa, Ontario
Canada—Saanichton, British Columbia
Canada—Lacombe, Alberta
Canada—Agassiz, British Columbia
Canada—Aklavik
Canada—Fort Simpson
Canada—Chimo
Canada—Kentville, Nova Scotia
Canada—Ellesmere Island
Canada—Cornwallis Island
Canada—St. Johns, Newfoundland
Alaska—Fairbanks
Alaska—Palmer
Alaska—Point Barrow

C. U. S. Department of Agriculture Sites Having Average Annual Rainfall of 32 Inches. (1958)

Danevang, Texas
Brenham, Texas
Dime Box, Texas
Thornton, Texas
Ferris, Texas
Sanger, Texas
Slidell, Texas
Marlow, Oklahoma
Chandler, Oklahoma
Tulsa, Oklahoma *
Bolivar, Missouri
Columbia, Missouri*
Springfield, Illinois*
Galva, Illinois
Marengo, Illinois
Portage, Wisconsin
Antigo, Wisconsin
Ontonagon, Michigan

* These locations were sampled in 1959 also.

D. Argonne National Laboratory

Lemont, Illinois

E. Health and Safety Laboratory—Pasture Program—Soil

Tifton, Georgia
New Brunswick, New Jersey
Raleigh, North Carolina
Ithaca, New York
Logan, Utah (College Farm)
Mandan, North Dakota
Brawley, California

F. Chicago Pasture Site Survey—Soil

Will County, Illinois (Van Winkle Farm—Carver Farm)
Columbia County, Wisconsin—(Premo Farm)
Rock County, Wisconsin (Holcomb Farm—Grabow Farm—Swain Farm)
Dane County, Wisconsin (Lewke Farm)
Winnebago County, Illinois (Swanson Farm)
McHenry County, Illinois (Kurpeski Farm—Austin Farm—McKee Farm)

G. U. S. Department of Agriculture--Health and Safety Laboratory (State Sites--1959)

Alabama, Birmingham
Arizona, Tucson
Arkansas, Little Rock
California, Los Angeles
California, Healdsburg
Colorado, Derby
Connecticut, Windsor
Delaware, Newark
Florida, Jacksonville
Georgia, Atlanta
Idaho, Boise
Illinois, Springfield
Indiana, W. Lafayette
Iowa, Des Moines
Kansas, Manhattan
Kentucky, Lexington
Louisiana, Alexandria
Maine, Orono
Massachusetts, Amherst
Massachusetts, S. Wellfleet
Michigan, Detroit
Minnesota, St. Paul
Mississippi, Newton
Missouri, Columbia
Montana, Bozeman
Nebraska, Lincoln
New Hampshire, Durham
New Jersey, New Brunswick
New York, Rochester
New York, Binghamton
New York, New York
North Carolina, Raleigh
North Dakota, Mandan
Ohio, Columbus
Oklahoma, Tulsa
Oregon, Corvallis
Oregon, Glendale
Pennsylvania, State College
Rhode Island, Kingston
South Carolina, Clemson
South Dakota, Rapid City
Tennessee, Knoxville
Texas, Waco
Utah, Salt Lake City
Vermont, Burlington
Virginia, Blacksburg
Washington, Puyallup
Washington, Clallam Bay
Washington, Sequim
Washington, Port Angeles
Washington, Joyce
Washington, Forks
Washington, Longview
West Virginia, Morgantown
Wisconsin, Madison
Alaska, Point Barrow
Alaska, Fairbanks
Alaska, Palmer
Hawaii, Oahu (4)

H. U. S. Department of Agriculture--Health and Safety Laboratory--West Coast Rainfall Study

Courtenay, B. C.
Douglas, B. C.
Sequim, Washington
Port Angeles, Washington
Clallam Bay, Washington
Joyce, Washington
Forks, Washington
Puyallup, Washington
Longview, Washington
Corvallis, Oregon
Glendale, Oregon
Sayers Bar, California*
Healdsburg, California
Big Sur, California*
Big Bear City, California*
Cuyamaca, California*

Note: This group of sites was established in 1957 except for Clallam Bay which was first sampled in 1959. Starred sites were not sampled in 1959 due to loss of the site by cultivation or rodent damage.

146<

FOOD CONSUMPTION OF HOUSEHOLDS IN THE UNITED STATES

As a necessary step in the evaluation of the radiological health aspects of radioactivity in foods, there must be estimates of the kinds and amounts of food consumed. The Department of Agriculture is preparing five sets of estimates of food consumption in the United States, the first of which deals with the country as a whole. The others have to do with the estimates for the following regions: Northeast, North Central, South, and West.

The first set of estimates has been completed and is reproduced in this issue for use by scientists in the fields of nutrition and radiological health. Values for calcium intake are included in the table of "Food Consumption of Households in the United States," for use when evaluating the intake of such radionuclides as strontium-90. The values of calcium will not be included in the tables of food consumption in other regions, which data will appear in subsequent issues of Radiological Health Data.

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Household Economics Research Division
Washington 25, D. C.

The following table showing average "per person quantities" of foods used per week (in pounds) and per day (in grams), has been derived from data in "Household Food Consumption Survey," 1955, Report No. 1, available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at $1.25.

Averages are for foods used at home during a week in the spring, as brought into the household, and are based on all housekeeping households in the nation. "Per person quantities" were computed by dividing "household quantities" by the "average household size" (3.33 persons for the United States as a whole). "Average household size" was derived by dividing by 21 the total number of meals served during the survey week from family food supplies.

For some purposes, information on the consumption of those actually using a given food is more useful than averages based on all persons. An approximate but not precise figure can be computed from these data. Information was obtained in the survey only on household use—not on the individual member use of foods. Estimated quantity of food per person may be obtained by dividing the "quantities used per person per week" based on all households by the "percentage of households using" shown in column 2. For example, the estimate of the average per-person use of commercially baked white bread per week in households is 1.39 pounds, derived by dividing 1.20 from the third column by 86.1 shown in the second column, page 28. Such an estimate understates the value for those actually using the food, since it is not reasonable to assume that all members of all households reporting use of the food actually used some of the item. The understatement is probably small for such items as bread, sugar, etc., that in many households are likely to be eaten by every member, but it may be considerable for items such as tea, coffee, or baby foods that are less likely to be used by all members.

The estimate of the quantity per person using an item computed from this table will also be understated when the average size of household utilizing food is smaller than the average of all households. The average size of households using lamb and mutton, for example, is approximately 3.07 instead of 3.33 persons (all U. S.) and the average per person per week in households using is 0.84 pounds rather than the 0.77 pounds computed from the figures in this table.

On the other hand, the estimated average computed from this table will be overstated when the average size of the households using is larger than that of all households. This is true for example, for such items as ice cream (3.55 persons) and breakfast cereals (3.48 persons).

While estimates computed from these data will provide an indication of the importance of an item in the individual diet, they do not show the maximum likely to be used, such as would be shown by the percentage distribution using specified amounts per person. Also, since the averages for those using the items are not additive, combinations of items cannot be easily estimated.

147<

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE

Food (1)	Households using (2)	Quantity per person		Calcium per person per day (5)
		In a week (3)	Per day (4)	
	Percent	Pounds	Grams	Milligrams
Milk, cream, ice cream, cheese (fluid milk equivalent[1]	99.6	9.56	620	733
Fresh fluid milk, total	93.6	7.14	463	548
Whole	90.5	6.46	419	495
Buttermilk	18.7	.38	24	30
Skim	5.9	.19	12	15
Chocolate (commercial)	5.4	.08	5	5
Half and half, extra rich	6.9	.04	3	3
Processed milk:				
Evaporated	35.1	.29	19	46
Condensed	2.3	.02	1	3
Dry, total	12.1	.03	2	20
Nonfat	7.2	.02	1	15
Whole	2.4	.01	(*)	4
Products, nonfat and whole[2]	3.1	.01	(*)	1
Cream, total[3]	24.0	.09	6	5
Light	7.2	.03	2	2
Heavy, whipped, whip topping	17.4	.06	4	3
Ice cream, ice milk (commercial)[4]	57.7	.37	24	29
Cheese, total	77.9	.32	21	82
Cottage	34.9	.13	8	5
Nonprocessed, total[5]	32.5	.07	5	28
American-type	16.4	.04	3	20
Swiss	3.8	.01	(*)	4
Cream	10.8	.02	1	1
Other	6.2	.01	1	3
Processed, total[6]	48.9	.12	8	49
American, Swiss, cream, other	43.0	.10	7	45
Cheese spreads	8.5	.01	1	3
Fats and oils, total	99.5	.89	58	7
Table fats, total	96.8	.40	26	6
Butter	59.7	.20	13	3
Margarine	58.1	.20	13	3
Shortening, total	71.7	.28	18	0
Lard[7]	26.3	.14	9	0
Other	49.6	.14	9	0
Salad and cooking oils	23.5	.06	4	0
Salad dressings (commercial), total	69.1	.15	10	1
Mayonnaise and mayonnaise-type	41.4	.07	4	1
French and french-type	16.0	.02	1	0
Other[8]	24.5	.07	4	(*)

---

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[1] Approximately the quantity of fluid milk to which the various dairy products (except butter) are equivalent in calcium.

[2] Chiefly dry cocoa mixes.

[3] Includes small amounts of powdered cream, not shown separately.

[4] Includes frozen custard and frozen desserts with vegetable fats.

[5] Includes quantities of cheese for which respondent could not report whether or not processed.

[6] Includes small amounts of cheese food, not shown separately.

[7] Includes small amounts of chicken fat.

[8] Includes sandwich spreads.

148<

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	Households using (2)	Quantity per person		Calcium per person per day (5)
		In a week (3)	Per day (4)	
	Percent	Pounds	Grams	Milligrams
Flour and other cereal products, total	97.5	1.76	114	87
Flour other than mixes, total	79.2	.80	52	47
White	79.0	.79	51	47
Other	1.8	.01	1	(*)
Prepared flour mixes, total	38.8	.18	12	23
Pancake	13.7	.04	3	12
Cake	19.4	.09	6	4
Biscuit, roll, muffin	11.6	.04	2	6
Other	7.6	.02	1	1
Breakfast cereals (excluding baby cereals), total	75.4	.25	16	5
Ready-to-eat, total	64.9	.17	11	3
Corn flakes	36.9	.07	4	(*)
Wheat, flaked, puffed, shredded	32.9	.06	4	2
Rice, flaked, puffed, etc	15.1	.02	1	(*)
Other	14.2	.02	1	1
Hot, total[9]	30.7	.08	5	2
Rolled oats, oatmeal	25.0	.06	4	2
Wheat cereals	9.5	.02	1	(*)
Other cereals, total	73.7	.53	35	12
Baby cereals	7.4	.01	1	3
Rice	28.2	.09	6	1
Cornmeal, grits, total	26.4	.28	18	6
Cornmeal	24.4	.24	16	6
Hominy grits	7.6	.03	2	(*)
Hominy (big)	2.3	.01	1	(*)
Macaroni, spaghetti, noodles	42.3	.13	8	2
Popcorn	8.1	.02	1	(*)
Other[10]	11.4	.01	(*)	(*)
Bakery products, total	97.3	2.01	130	98
Bread, total	94.0	1.41	92	74
White[11]	86.1	1.20	77	61
Whole wheat	16.2	.09	6	6
Other	26.9	.13	8	7
Baked goods other than bread, total	82.5	.60	39	24
Crackers, total	54.6	.14	9	1
Sweet	12.1	.03	2	(*)
Not sweet	50.0	.11	7	1
Rolls, total	20.4	.06	4	2
Ready-to-eat	12.5	.04	2	1
Brown and serve	8.8	.03	2	1
Biscuits, muffins	8.4	.03	2	4
Cakes	22.4	.11	7	8
Pies	10.7	.06	4	1
Other[12]	49.6	.20	13	8

*Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[9] Includes small amounts of other hot cereals not shown separately.

[10] Includes tapioca, cornstarch, barley, buckwheat grits.

[11] Practically all reported as enriched.

[12] Includes cookies, doughnuts, sweet buns, coffee cake, etc.

149<

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE--Con.

Food (1)	Households using (2)	Quantity per person		Calcium per person per day (5)
		In a week (3)	Per day (4)	
	Percent	Pounds	Grams	Milligrams
Eggs	97.9	0.84	55	26
Meat, poultry, fish, total	99.5	4.14	268	32
Meat, total	99.3	3.03	197	18
Beef, total	88.7	1.25	81	8
Steak, fresh, frozen, total	52.1	.39	25	2
Round	26.6	.17	11	1
Other	32.5	.22	14	1
Roast, fresh, frozen, total	32.0	.35	22	2
Rib	7.1	.08	5	(*)
Other	25.6	.27	17	2
Stewing, boiling, fresh, frozen	18.8	.11	7	1
Corned, chipped, dried	6.9	.02	1	(*)
Ground, fresh, frozen	61.6	.38	24	3
Canned (commercial)	3.2	(*)	1	(*)
Veal, total[13]	12.6	.08	5	(*)
Roast, shoulder, fresh, frozen	2.6	.02	2	(*)
Chops, cutlets, fresh, frozen	9.3	.05	3	(*)
Pork, total	90.0	1.14	74	7
Fresh, frozen, total	55.7	.49	32	3
Chops	34.2	.19	12	1
Ham	4.3	.04	3	(*)
Loin	7.6	.08	5	1
Sausage	20.6	.09	6	
Other	11.8	.10	6	1
Cured, smoked, total	81.4	.63	41	4
Ham, raw, precooked	31.9	.26	17	1
Bacon	66.8	.25	16	2
Salt pork	12.3	.05	4	0
Other	11.6	.07	4	1
Canned (commercial)	2.3	.02	2	(*)
Lamb, mutton, total	11.6	.09	6	(*)
Chops, steak, fresh, frozen	7.6	.04	3	(*)
Roast, shoulder, leg, fresh, frozen	3.2	.04	3	(*)
Stewing, soup, ground, patties	1.3	.01	(*)	(*)
Variety meats and game, total	23.6	.11	7	1
Liver	19.0	.07	4	1
Other[14]	6.3	.04	3	
Luncheon meats, total	69.2	.36	24	2
Frankfurters	39.0	.15	10	1
Other, total	55.9	.22	14	1
Canned	6.2	.02	1	(*)
Other	53.0	.20	13	1
Poultry, total[15]	55.2	.71	46	5
Chicken[16]	53.2	.63	41	4
Turkey[16]	2.5	.06	4	1

---

*Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[13] Includes small amounts of other veal, not shown separately.

[14] Includes tongue, kidney, heart, tripe, etc.; game.

[15] Includes small amounts of other poultry, not shown separately.

[16] Chiefly fresh or frozen, only small amounts of canned reported.

150<

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	Households using (2)	Quantity per person		Calcium per person per day (5)
		In a week (3)	Per day (4)	
	Percent	Pounds	Grams	Milligrams
Meat, poultry, fish—Con.				
Fish and shellfish, total	63.1	0.40	26	9
Fish, total[17]	58.8	.34	22	8
Canned (commercial), total	35.0	.09	6	6
Salmon	12.7	.04	2	6
Tuna	21.5	.04	2	(*)
Other[18]	5.4	.01	1	(*)
Fresh, frozen	33.2	.25	16	2
Shellfish, fresh, frozen, canned	11.8	.06	4	1
Sugar, sweets, total	97.5	1.25	81	14
Sugar, total	94.8	.83	54	1
White, total	94.6	.80	52	0
Granulated	94.4	.74	48	0
Confectioners, powdered	17.7	.05	4	0
Brown	14.0	.03	2	1
Sirups, molasses, honey, total	37.3	.13	8	4
Sirups, total	29.5	.10	7	2
Corn, cane	14.3	.06	4	1
Maple, sorghum, other[19]	16.3	.05	3	1
Molasses	4.3	.01	1	2
Honey	7.2	.02	1	(*)
Jellies, jams, total	62.8	.18	11	2
Jellies	36.7	.08	5	1
Jams, preserves, fruit butters, etc.	35.1	.09	6	1
Candies (commercial), total	40.0	.11	7	7
With nuts	13.9	.03	2	4
Without nuts	30.6	.08	5	3
Potatoes, sweetpotatoes, total	93.0	1.87	121	12
Fresh, total	91.6	1.80	117	11
White	90.9	1.75	113	10
Sweetpotatoes	8.0	.06	4	1
Frozen[20]	4.3	.01	1	(*)
Canned, dehydrated[21]	3.9	.02	1	(*)
Potato chips and sticks[22]	20.2	.04	2	1
Fresh vegetables, total[23]	98.1	2.66	172	57
Dark green and deep yellow, total[24]	69.4	.42	27	23
Dark green leafy, total	26.6	.16	10	16
Spinach	8.2	.03	2	1
Other	20.8	.12	8	15
Broccoli	4.6	.03	2	3
Carrots	51.5	.20	13	4
Peppers, green	21.0	.03	2	(*)

*Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[17] Includes small amounts of smoked, cured fish, not shown separately.

[18] May include small amount of ready-cooked fish, not canned.

[19] See page 33 for chocolate sirup.

[20] Chiefly french fried.

[21] Chiefly canned sweetpotatoes.

[22] Chiefly chips.

[23] Includes home canned and frozen vegetables that were brought into the home in fresh form.

[24] Includes other dark green and deep yellow vegetables not shown separately.

151<

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	Households using (2)	Quantity per person		Calcium per person per day (5)
		In a week (3)	Per day (4)	
	Percent	Pounds	Grams	Milligrams
Fresh vegetables—Con.				
Other green, total	88.9	1.05	68	21
Asparagus	16.5	.10	6	1
Beans, snap, wax	28.7	.18	12	7
Cabbage	37.4	.30	19	7
Lettuce	72.1	.36	23	4
Peas	8.7	.05	4	1
Other	8.7	.05	3	1
Tomatoes	62.0	.35	23	2
Other than tomatoes and green and deep yellow, total	90.4	.84	54	11
Celery	42.1	.12	8	3
Cucumbers	22.9	.08	5	(*)
Mature onions	65.7	.23	15	4
Green onions	26.9	.07	4	2
Other, total[25]	48.8	.35	23	2
Corn	18.5	.16	11	(*)
Fresh fruits, total[26]	91.3	2.86	185	23
Citrus, total[27]	66.2	1.17	76	12
Grapefruit	25.5	.34	22	2
Lemons, limes[28]	28.8	.10	6	(*)
Oranges	45.5	.73	47	10
Other than citrus, total[29]	83.9	1.69	110	11
Apples	44.0	.39	25	1
Bananas	56.2	.44	28	2
Melons	13.2	.34	22	2
Rhubarb	9.1	.06	4	1
Strawberries	20.6	.17	11	3
Avocados	5.3	.02	1	(*)
Berries other than strawberries	6.3	.04	3	1
Cherries	6.0	.04	2	(*)
Peaches	11.5	.09	6	(*)
Other	12.7	.10	6	1
Commercially frozen fruits and vegetables	34.9	.17	11	6
Fruits[30]	9.6	.03	2	(*)
Vegetables other than potatoes, total	30.2	.14	9	6
Beans, lima	7.7	.02	1	1
Beans, snap, wax	6.0	.02	1	1
Broccoli	7.5	.02	1	1
Peas	11.6	.03	2	(*)
Spinach	5.0	.01	1	1
Corn	3.5	.01	1	(*)
Other	11.5	.03	2	2

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[25] Includes beets, cauliflower, turnips, rutabagas, and others not shown separately.

[26] Includes home canned and frozen fruits that were brought into the home in fresh form.

[27] Includes small amounts of tangerines and kumquats not shown separately.

[28] Chiefly lemons.

[29] Includes small amounts of figs and grapes not included in "Other."

[30] Chiefly strawberries.

152<

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)	Calcium per person per day (5)
	Percent	Pounds	Grams	Milligrams
Commercially canned fruits and vegetables, total..	84.1	1.23	80	11
Fruits, except baby and junior foods, total	52.7	41	27	1
Apples, applesauce	15.4	.07	4	(*)
Apricots	4.4	.02	1	(*)
Berries..........	3.9	.01	1	(*)
Cherries..........	6.0	.02	1	(*)
Peaches	21.1	.12	8	(*)
Pears	9.5	.04	3	(*)
Pineapple	16.0	.06	4	1
Plums, prunes..........	1.8	.01	1	(*)
Mixed fruit, fruit cocktail	10.2	.05	3	(*)
Other	4.5	.02	1	(*)
Baby, junior foods, incl. juices..........	8.3	.04	3	(*)
Vegetables, except baby and junior foods, total[31]	73.7	.75	49	9
Asparagus..........	5.9	.02	1	(*)
Baked beans, or other mature beans..........	13.9	.07	5	2
Beans, lima, green, immature..........	5.1	.02	1	(*)
Beans, snap, wax	23.5	.11	7	2
Beets..........	11.1	.04	2	(*)
Corn	29.7	.13	9	(*)
Peas, green, immature	32.1	.14	9	2
Tomatoes, total..........	24.2	.12	8	1
Pulp	15.5	.09	6	1
Puree, paste	12.2	.03	2	(*)
Other	25.2	.10	7	2
Baby, junior foods, incl. potatoes..........	5.8	.02	2	1
Fruit and vegetable juices, fresh, frozen, canned, powdered[32, 33]	60.7	1.05	68	7
Canned citrus, total[32, 34]	21.5	.28	18	1
Orange	12.3	.17	11	1
Grapefruit..........	7.4	.07	5	(*)
Canned fruit other than citrus[32]..........	19.2	.17	11	2
Canned tomato and other vegetable juices[32, 35]	22.3	.18	12	1
Frozen, concentrated, total	23.5	.11	7	
Orange	21.1	.09	6	2
Other	5.0	.01	1	1
Fresh (commercial)..........	2.9	.04	2	
Dried fruits and vegetables, total[36]	43.0	.18	12	13
Dried fruit, total	20.5	.05	4	2
Prunes..........	8.2	.02	2	1
Raisins, currants	11.0	.02	1	1
Other	4.5	.01	1	(*)

---

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[31] Includes small amount of mature peas not included in "Other."

[32] Single strength equivalent.

[33] Does not include baby or junior juices. See above.

[34] Includes orange and grapefruit blend and other citrus juices not shown separately.

[35] Includes both commercially and home-canned and frozen juices.

[36] Includes both commercially and home-dried fruits and vegetables.

153<

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)	Calcium per person per day (5)
	Percent	Pounds	Grams	Milligrams
Dried fruits and vegetables—Con.				
Dry vegetables, total	28.8	0.13	8	11
Beans, total	25.1	.11	7	10
Lima	7.7	.03	2	1
Navy, pinto, kidney, other	19.3	.08	5	9
Peas, lentils, other	6.4	.02	1	1
Beverages:				
Coffee, total[37]	91.2	.24	16	0
Bean, ground	74.1	.23	15	0
Instant, powdered	22.7	.01	1	0
Substitute	3.3	(*)	(*)	0
Tea[38]	26.2	.03	2	0
Chocolate, cocoa, chocolate sirup, total	23.9	.03	2	1
Chocolate	6.0	.01	(*)	(*)
Cocoa	15.8	.01	1	1
Chocolate sirup	3.5	.01	1	(*)
Soft drinks, fruit ades, total	59.2	.90	58	(*)
Soft drinks, bottled and canned, total	53.1	.87	56	0
Cola-type	35.5	.54	35	0
Fruit flavored	11.5	.14	9	0
Other	17.3	.19	12	0
Powdered	7.8	.01	(*)	0
Fruit ades, total	6.7	.03	2	(*)
Frozen	4.5	.01	1	(*)
Other	2.3	.02	1	(*)
Miscellaneous foods:				
Nuts (shelled weight) and peanut butter, total	46.0	.09	6	5
Nuts (shelled weight), total	19.5	.03	2	2
Peanuts	6.8	.01	1	1
Other	14.0	.02	1	1
Peanut butter	34.6	.06	4	3
Soups, except canned baby soups, total	42.7	.21	14	4
Vegetable, total	29.0	.12	8	2
Condensed	25.4	.11	7	2
Other	3.6	.01	(*)	(*)
Meat, fish, grain, total	24.1	.09	6	2
Condensed	20.8	.09	6	2
Other	4.3	.01	1	(*)
Catsup, chili sauce, etc., total[39]	47.8	.11	7	1
Catsup	40.3	.07	4	1
Chili sauce	3.6	.01	(*)	(*)
Barbecue sauce, etc.	9.7	.03	2	(*)
Tomato relishes	2.8	.01	(*)	(*)
Pickles, olives, relishes, total[39]	43.0	.14	9	3
Pickles	34.8	.12	8	2
Olives	12.4	.02	1	1
Relishes other than tomato	5.4	.01	1	(*)

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[37] Includes small amounts of liquid concentrate coffee, not shown separately.

[38] Data refer to amounts bought during the 7-day survey period rather than the amounts used.

[39] Includes both commercial and homemade products.

TABLE XI.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE UNITED STATES, 1955—U. S. DEPARTMENT OF AGRICULTURE—Con.

Food	Households using	Quantity per person		Calcium per person per day
		In a week	Per day	
(1)	(2)	(3)	(4)	(5)
	Percent	Pounds	Grams	Milligrams
Miscellaneous foods—Con.				
Puddings, pie fillings, miscellaneous sweets (commercial), total[40]	40.7	0.08	5	1
Puddings, pie fillings[41]	34.6	.05	3	(*)
Strained canned puddings (baby)	3.4	.01	1	(*)
Sherbets, ices	5.7	.02	1	1
Icing mix, fudge mix	2.6	.01	(*)	(*)
Other mixtures, prepared or partially prepared, total	32.3	.18	12	3
Mixtures other than baby, junior foods, total	28.2	.15	10	3
Without meat[42]	11.5	.05	3	1
With meat[43]	20.3	.10	7	2
Baby, junior foods, total	6.7	.03	2	(*)
Meat, mixtures with meat	6.3	.03	2	(*)
Without meat	1.9	(*)	(*)	(*)
Leavening agents, total[44]	18.6	.03	2	(*)
Yeast	8.1	(*)	(*)	(*)
Other[44]	11.7	.03	2	0
Seasonings:[44]				
Vinegar	10.3	.06	4	0
Salt	22.3	.11	7	0

* Less than 0.005 pounds or 0.5 grams or 0.5 milligrams.

[40] Includes other miscellaneous sweets not shown separately.

[41] Chiefly dry, including plain gelatin.

[42] Includes spaghetti with tomato sauce, potato salad, cole slaw, macaroni and cheese dinners, chow mein and chop suey dinners, and others.

[43] Includes poultry and meat pies, spaghetti with meat balls, corned beef hash, chili con carne, ravioli, tamales, and others.

[44] Data refer to amount bought during the 7-day survey period rather than the amounts used.

SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH

The following summary of state activities in radiological health are included as an informational service to those in this field of work. Any corrections and/or comments are solicited. Further reporting of state activities in radiological health is planned for future issues of Radiological Health Data. Contributions from the states are most welcome.

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH

		Alabama 4-5-60	Alaska 6-15-60	Arizona 3-28-60	Arkansas 6-15-60	California 6-15-60	Colorada 5-13-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	Yes—model APHA Rad. Protection Act, without Commission, eff. 3-18-57	No (proposed)	Yes—model APHA Radiation Protection Act, without Commission; by authority House Bill 413, eff. 6-11-59	Limited—(coverage of waste disposal)	Yes—by authority House Bill 104, eff. 3-13-57 (not model APHA RPA)
RADIATION CODE or REGULATIONS		No (proposed)	No (proposed)	No	No	Limited—General Industry Safety Order Resolution 88, eff. 1-25-57	Yes—eff. 10-12-59 (based on Handbook 61)
REGISTRATION of RADIATION SOURCES REQUIRED		No	Yes	No (proposed)	Yes—(see Enabling Act)	Yes	Yes—by authity House Bill 140, eff. 2-10-58
SHOE FITTING FLUORO-SCOPES	REGULATED	No		No		1959. Yes—by authority of Chapter 362	No
	BANNED	No	Yes	No	Yes—by authority Act No. 133, Laws of 1959 app. 3-3-59		No
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Nuclear Advisory Committee	Yes—by authority House Bill 49, Sec. 5, eff. 4-27-59	No (proposed)	Yes—by authority House Bill 853, eff. 3-27-57	Yes—effective 8-1-59	No
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No		No	No		Yes
REMARKS		Programs inventoried 7-15-59	Programs inventoried 5-20-59	Programs inventoried 5-25-59	Programs inventoried 7-22-58	Programs inventoried 7-22-58	Programs inventoried 7-24-58

APHA RPA—American Public Health Association, Radiation Protection Act.

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Connecticut 6-20-60	Delaware 6-15-60	District of Columbia 6-15-60	Florida 4-4-60	Georgia 3-15-60	Hawaii 3-18-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		Yes—by authority of Sec. 19-24 of the 1958 Revision of State Statutes (not a model APHA RPA)	No	No	Yes—by authority of State Statutes of 1955 Chap. 381 and 387 which provide for Environmental Hlth. Codes, Rules and Regulations (not a model APHA RPA)	No	Yes
RADIATION CODE or REGULATIONS		Yes—by authority of the State Sanitary Code, Regulation 287 and Gen. Statutes	Yes	No	No (proposed)	No—(have a Water Control Act, Sec. 6, Para. A, eff. 3-17-57 which provides for limited regulation)	No (proposed)
REGISTRATION of RADIATION SOURCES REQUIRED		Yes—by authority of Sec. 19-24 and 19-2512-55 of the 1958 Revision of State Statutes	Yes—eff. 12-55	No (proposed)	No (proposed)	No	Yes
SHOE FITTING FLUOROSCOPES	REGULATED	No	No	Yes	Yes	Yes 1-52	No
	BANNED	Yes—by authority of Sec. 53-212a of the 1958 Revision of Statutes	Yes—eff. 3-1-58	No	No	No	No (proposed)
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes—by authority of Sec. 19-49 of the 1958 Rev. of Statutes	No	No	Nuclear Development Commission	Yes—Nuclear Advisory Commission	No (proposed)
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	No	No	No	No	Yes—Advisory Committee on Radiological Health
REMARKS					Programs inventoried 5-25-59	Programs inventoried 7-17-58	Programs inventoried 5-59

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Idaho 5-13-60	Illinois 6-16-60	Indiana 6-16-60	Iowa 6-16-60	Kansas 6-16-60	Kentucky 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	Yes--model APHA Radiation Protection Act, eff. 7-17-59	Yes—model APHA Radiation Protection Act as authorized by State Acts of 1959, Chap. 77, eff. 7-21-59	No (proposed)	Yes--by authority of House Bill 376, eff. 7-1-59 (not model APHA RPA)	No
RADIATION CODE or REGULATIONS		Yes--eff. 8-4-58	No (proposed)	No	No	No	Yes--by authority of Revised State Statutes, eff. 9-23-59
REGISTRATION of RADIATION SOURCES REQUIRED		Yes—(other than Healing Arts)	Yes—effective 7-5-57	Yes	No (proposed)	Yes--(see Enabling Act)	Yes—by authority of Revised State Statutes eff. 9-23-59
SHOE FITTING FLUOROSCOPES	REGULATED	No	No	No	No	No	
	BANNED	No	Yes	Yes—eff. 7-21-59	No	Yes—eff. 9-12-58	
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes—Governor's Committee	Yes—Commission	No	No	Yes--by authority of House Bill 175	
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No (Ad Hoc Committees)	Yes	Yes--Advisory Commission as authorized by Senate Bill 200	No	Yes--Advisory Council	
REMARKS		Programs inventoried 2-10-59	Programs inventoried 6-16-59				

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Louisiana 6-16-60	Maine 6-16-60	Maryland 6-16-60	Massachusetts 6-16-60	Michigan 6-16-60	Minnesota 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	No	No (proposed)	Yes—by authority of House Bill 2650, eff. 12-30-58 (not model APHA RPA)	Yes—by authority of House Bills 303 and 243, eff. 1-1-59 (not model APHA RPA)	Yes—by authority of Chap. 361 of 1957, eff. 4-11-57
RADIATION CODE or REGULATIONS		No	No	No	Yes—by authority of Chap. 453 1957, eff. 6-21-57	Yes	Yes
REGISTRATION of RADIATION SOURCES REQUIRED		No	Yes—by authority of State Regulations eff. 12-30-58	No (proposed)	Yes	Yes	Yes
SHOE FITTING FLUOROSCOPES	REGULATED	No	No	No		Yes	No
	BANNED	Yes—eff. 7-1-58	Yes—by authority of House Bill 360, 1959	No	Yes—eff. 11-50	No	Yes—eff. 12-58
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes	Yes—Coordinator, by authority of Rev. St. Statutes eff. 8-20-55	No	Yes—Coordinator and Commission	No	No
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	No	No	No (proposed)	No	No
REMARKS		Programs inventoried 6-3-59	Programs inventoried 9-12-58			Programs inventoried 6-12-59	

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Mississippi 3-15-60	Missouri 6-16-60	Montana 5-13-60	Nebraska 6-16-60	Nevada 6-16-60	New Hampshire 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	No (proposed)	No (have limited authority under Industrial Hygiene Act and Hospital Licensing Laws)	No	No	No (proposed)
RADIATION CODE or REGULATIONS		No	No	No	No	Yes	No
REGISTRATION of RADIATION SOURCES REQUIRED		No	No (proposed)	No	No	No (proposed)	No (proposed)
SHOE FITTING FLUORO-SCOPES	REGULATED	No	No	No	No	No	No
	BANNED	Yes--eff. 7-58	No	Yes--effective 4-58	No	No	No
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes--Governor's Committee	Yes--commission by authority Senate Bill 6, eff. 3-4-59	No	Yes--Coordinator and Committee--by authority Legislative Bill 365 eff. 6-25-59	No	Yes. 8-55
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	No	No	No	No	No
REMARKS			Programs inventoried	Programs inventoried 6-30-59		Programs inventoried 7-8-59	

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		New Jersey 3-22-60	New Mexico 6-16-60	New York 6-16-60	North Carolina 6-16-60	North Dakota 6-16-60	Ohio 3-30-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		Yes—model APHA RPA by authority of Pub. Laws, Chap. 116, 1958	Yes—by authority of Sen. Bill 61, eff. 6-12-59 (not model APHA RPA)	Yes—by authority of Pub. Hlth. Law. Sec. 201 (s)	Yes—by authority of Sen. Bill 253, eff. 5-21-59 (not model APHA-RPA)	No	Yes—model APHA RPA
RADIATION CODE or REGULATIONS		Yes—by authority RPA. Act in 2 parts: Chap. 1, Gen. Requirements. Chap. 11, Spec. Requirements.	No (authorized by Enabling Act)	Yes	No (proposed)	No	No
REGISTRATION of RADIATION SOURCES REQUIRED		Yes (see Enabling Act	Yes—by authority of Enabling Act	Yes	No (proposed)	Yes	No (proposed)
SHOE FITTING FLUOROSCOPES	REGULATED	Yes—eff. 1-15-53	No	No	No	No—authority by Chap. 185, 1957	No
	BANNED	No	Yes—by authority of Sen. Bill 6, eff. 6-59	Yes—eff. 7-1-58	No	No	Yes—by authority of House Bill 294, eff. 5-58
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	No	Yes	Yes—Coordinator and Committee	Yes—Advisory Com. to Governor	No	Yes—by author thority of Senate Bill 339, eff. 6-12-57
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	Yes--Com. on Rad. Protection by authority Enabling Act	Yes—by authority Enabling Act	Yes—Intra-departmental Committee	Yes—by authority of Enabling Act	No	Yes—by authority of House Bill 410, eff. 2-60
REMARKS		Programs inventoried	Programs inventoried 5-25-59	Programs inventoried 8-25-58	Programs inventoried 1-27-59		Programs inventoried 8-4-58

161<

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Oklahoma 4-4-60	Oregon 6-16-60	Pennsylvania 3-21-60	Rhode Island 6-16-60	South Carolina 6-16-60	South Dakota 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		Yes—by authority of House Bill 583, eff. 7-16-59 (broad gen. act which exempts healing arts)	Yes—1957	No (proposed)	No (proposed)	No	No
RADIATION CODE or REGULATIONS		No (proposed)	No (proposed)	Yes—by authority of Regulation 433 adopted 10-20-56	No (proposed)	No	No
REGISTRATION of RADIATION SOURCES REQUIRED		No (proposed)	No	Yes	No (proposed)	No	Yes
SHOE FITTING FLUOROSCOPES	REGULATED	No	No	No	No	Yes	No
	BANNED	No	Yes—1958	Yes	No	No	Yes 9-57
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes—advisory committee, by authority of House Bill 583 1959	No	No (proposed)	Yes—Governor's Committee on Atomic Energy	Yes—Committee, authorized by Act 171, 3-25-59	No
	COMMITTEE ON RADIATION (TO STATE HEALTH AGENCY)	Yes—Committee on Rad. Legislation	Yes—by authority Chap. 339, eff. 7-1-57	Yes	No	No	No
REMARKS		Programs inventoried 7-30-58	Programs inventoried 12-12-58	Programs inventoried 6-3-59	Programs inventored 2-13-59		

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		Tennessee 3-18-60	Texas 3-28-60	Utah 5-13-60	Vermont 6-16-60	Virginia 6-16-60	Washington 6-16-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		Yes—by authority of Pub. Acts Chap. 66, eff. 7-1-57	No (proposed)	No	No (proposed)	No (proposed)	Yes—(limited)
RADIATION CODE or REGULATIONS		No (proposed)	Yes—by authority of House Bill 71 of 1959 (Workman's Compensation)	No	No	No	No
REGISTRATION of RADIATION SOURCES REQUIRED		Yes	Yes	No (registration of isotopes requested)	No (proposed)	No (proposed)	No (proposed)
SHOE FITTING FLUOROSCOPES	REGULATED	Yes	No	No	No	No	No
	BANNED	No	Yes	No	Yes 6-57	Yes 3-58	No
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	Yes—Advisory Committee, by authority of Chap. 324, eff. 1957	Yes—Governor's Study Commission	No	No	No (proposed)	Yes
	COMMITTEE on RADIATION (TO STATE HEALTH AGENCY)	No	No	Yes	No	No	No
REMARKS		Programs inventoried	Programs inventoried 7-17-58	Programs inventoried 2-16-59	Programs inventoried 11-20-58		Programs inventoried 7-15-59

TABLE XII.—SUMMARY OF STATE ACTIVITIES IN RADIOLOGICAL HEALTH—Con.

		West Virginia 6-16-60	Wyoming 6-16-60	Wisconsin 3-21-59	Puerto Rico 4-21-60	Virgin Islands 4-21-60
ENABLING ACT or LEGISLATION for RADIOLOGICAL HEALTH ACTIVITIES		No	No	No (proposed)	No	No
RADIATION CODE or REGULATIONS		No	No	No	No	No
REGISTRATION of RADIATION SOURCES REQUIRED		No	Yes	No (proposed)	No (proposed)	No
SHOE FITTING FLUORO-SCOPES	REGULATED	Yes	Yes—by authority of Gen. Hlth. Laws Feb. 1952	No	No	No*
	BANNED	No	No	Yes—eff. 7-59	No	No*
ADVISORY BODY	ATOMIC ENERGY COORDINATOR or COMMITTEE	No	No	Yes—Committee	No	No
	COMMITTEE or RADIATION (TO STATE HEALTH AGENCY)	No	Yes	No (proposed)	Yes—Radiation Protection Unit, Dept. of Health organized in October 1959	No
REMARKS			Programs inventoried 2-12-59			*There are no shoe fitting fluoroscopes operating to date

RADIATION EXPOSURES FROM FALLOUT

The Atomic Energy Commission has released a report on radiation exposures in the United States from nuclear test fallout, with special references to the short lived isotopes present in the fallout debris and to the existence of "hot spots." The summary of this report, prepared by the Division of Biology and Medicine, AEC, is reproduced below. The report will be reproduced as Technical Information Services document TID 8527 and made available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

THE CONTRIBUTION OF SHORT LIVED ISOTOPES AND HOT SPOTS TO RADIATION EXPOSURE IN THE UNITED STATES FROM NUCLEAR TEST FALLOUT

SUMMARY

This report is concerned with the extent to which segments of the United States population have received or will receive radiation doses due to radioactive fallout from nuclear testing to date which are significantly higher than the average for the country as a whole. The question of the biological effect or acceptability of such doses is not considered, but average natural background exposure is given as a reference level for comparison. Both short and long lived isotopes in the fallout are considered, and irradiation from internal and external sources.

Estimates are given of the average and above-average doses to the whole body and to the bone, bone marrow, and thyroid. These organs have received larger doses than has the whole body due to their internal concentration of the radioactive isotopes of strontium, barium or iodine.

The very complicated subject of exposure of the population to medical and industrial sources or radiation—sometimes used as a basis for evaluating the hazards due to fallout—has not been studied here. Some background material on this subject may be found in Appendix V. *

In accordance with accepted practice, a 70-year dose is given as a rough measure of the hazard to the present generation. It should be noted, however, that the biological effects of a given 70-year dose depend upon when this dose is delivered throughout the lifetime of an individual. Similarly a 30 year dose is given as a rough measure of the hazard to future generations. Finally a 1-year dose is given as a more appropriate measure of the hazard to infants and children, who may have especial sensitivity to radiation. For the evaluation of some biological effects, it may also be necessary to consider doses over time intervals much shorter than one year. For example, there are evidently times during the first three months of pregnancy when the fetus is particularly sensitive to injury from radiation. Due to short lived activities, there are many situations in which the 70-year dose from fallout may be delivered largely in a period of a few months.

Estimates of above-average doses are made only for situations for which data are available and indicate a relatively high exposure, and not for all cases of interest.

The numerical conclusions concerning the average doses in the U. S. to the whole body and to specific organs from testing to date are shown in Table S-1.

The time interval over which the estimates of Table S-1 apply are those intervals of 1,30, and 70 years for which a critical segment of the U. S. population receives the largest dose. For whole body external gamma radiation, the 30 and 70 year doses from testing to date would be largest for persons living from about 1950 to 1980, and 1950 through 2020 respectively. The largest strontium-90 concentrations in the bone are estimated to occur in children born in 1962-1963, and the calculations of the 30 and 70-year bone doses were made starting at the time. Strictly speaking then, it is not correct to add the maximum 30 and 70 year whole body external gamma doses to the maximum 30 and 70 year whole body strontium-90 bone doses when computing the maximum 30 and 70 year total bone doses, although this has been done in Table S-1.

Such an addition of the whole body dose to that of specific organs from internal emitters has not been made to obtain an estimate of the highest 1 year average dose to the bone, bone marrow, and thyroid since the year with the highest annual doses to each of these specific organs from internal emitters does not overlap the year with the highest whole body dose.

Estimates of the above-average doses are summarized in Table S-2.

Perhaps the most surprising above average doses given in Table S-2 are those to the thyroids of infants in areas where the highest concentrations of the short lived isotope Iodine-131 (8 day half life) were reported in milk. This dose in St. Louis for the year starting in May 1957 was computed to be 1900 mrad, or 19 times that delivered to the thyroid by the average natural backround radiation for that year. The similarly computed dose for the following year was 600 mrad.

---

*Appendices referred to in the summary are contained in the original document.

TABLE S-1.—AVERAGE DOSES TO PEOPLE IN THE U. S. TO THE WHOLE BODY AND TO SPECIFIC ORGANS FROM FALLOUT FROM NUCLEAR TESTS CONDUCTED THROUGH 1958 AND FROM NATURAL BACKGROUND RADIATION

(All doses expressed in millirads)

	For 1 year period	For 30 year period	For 70 year period
Average whole body—Gonadal dose from fallout	11-14	45-100	50-130
From external gamma radiation	10-12	40-60	45-65
From internal cesium	1-2	5-40	5-65
AVERAGE WHOLE BODY—GONADAL DOSE FROM NATURAL BACKGROUND RADIATION	100	3,000	7,000
Average bone dose from fallout to children born in U. S. in 1962-63	-	480-540	740-820
From strontium-90	21	440	690
From whole body radiation	11-14	45-100	50-130
AVERAGE BONE DOSE FROM NATURAL BACKGROUND RADIATION	130	3,900	9,100
Average bone marrow dose from fallout to children born in U. S. in 1962-63	-	190-250	280-360
From strontium-90	7	150	230
From whole body radiation	11-14	45-100	50-130
AVERAGE BONE MARROW DOSE FROM NATURAL BACKGROUND RADIATION	95	2,900	6,700
Average thyroid dose from children under 10 from fallout	-	240-500	250-530
From radioactive iodine in fallout	100-200	200-400	200-400
From whole body radiation	11-14	45-100	50-130
AVERAGE THYROID DOSE FROM NATURAL BACKGROUND	100	3,000	7,000

The largest above-average doses reported were those to the whole body for persons within 200 miles of the Nevada Test Site. Of the 180,000 persons concerned, 120,000 received whole body external gamma doses lying between 100 and 6,000 mrads with an average exposure of 700 mrads. This is 14 times the average 30 year external gamma exposure from fallout of about 50 mrad. As shown in Table S-2, about 10,000 persons received whole body, external gamma doses in the range of 3000 to 5000 mrad. No information is available on the Iodine-131 content of milk in the Nevada Test Site area for the periods of active testing.

It may be noted that some of the doses, such as those to the thyroid from Iodine-131 were essentially delivered within 3 months from the time nuclear testing stopped. Others, such as those to the bone from the long lived isotope strontium-90 will be delivered slowly over the lifetime of the individuals being born today and in the next few years. A tabulation of the half lives of those radioactive isotopes contained in fallout which receive individual attention in this report, together with a schedule of the fraction of the total dose from each of them which is delivered by the expiration of one or more half lives after intake, is given in Appendix IV.

In addition to the information presented in Table S-2, estimates have been made of some external and internal doses from particular instances in which fallout from the Nevada Test Site has been depos-

TABLE S-2.–ESTIMATES OF SOME ABOVE-AVERAGE DOSES IN THE U. S. TO THE WHOLE BODY AND TO SPECIFIC ORGANS FROM FALLOUT FROM NUCLEAR TESTS CONDUCTED THROUGH 1958

(All doses expressed in millirads)

Whole body external gamma dose from local fallout to persons within 200 miles of the Nevada Test Site

76,000 persons	100-300
26,000 persons	300-1,000
10,000 persons	1,000-3,000
9,000 persons	3,000-5,000
100-500 persons	5,000-6,000

Most of the cumulative 70 year (lifetime) dose here indicated for persons within 200 miles of the Nevada Test Site were delivered during the years of actual testing from the from the short-lived isotopes in the fallout.

Thyroid dose from iodine I-131 estimated for infants raised on fresh cow's milk from the milk-sheds surrounding several U. S. cities for the period May 1957 through April 1958

St. Louis, Mo.	1,900
Salt Lake City, Utah	1,800
Cincinnati	1,000
New York City	580
Sacramento	220

The thyroid doses reported here are those due to nuclear tests conducted since 1957, and are based on reported I-131 (half life 8.1 days) concentrations in milk. Similar data are not available for the period before 1957. (See p.2524, Ref. 6 for list of Nevada tests prior to 1957.) Short lived isotopes of iodine may increase the dose reported in the range of 15 to 40 percent if ingestion begins within 50 hours following detonation. Some dose possible from inhalation.

	Highest for 1 year	Highest for 30 years	Highest for 70 years
Strontium-90 bone dose to 1% of children born in U. S. in 1962-63	100	2,200	3,500
Strontium-90 bone marrow dose to 1% of children born in 1962-63	35	730	1,200
Average strontium-89 bone dose to infants in St. Louis, Mo., born in May 1958, and subsequently fed for 1 year with fresh cow's milk. (St. Louis milk had the highest reported average concentration of strontium-89 for a 1 year period)	50	55 (assuming no more Sr-89 ingested after May 1959)	55 (assuming no more Sr-89 ingested after May 1959)
Average strontium-90 bone dose to infants in St. Louis, Mo., born in May 1958 and subsequently fed with fresh cow's milk	30	-	-
Average Ba-140 dose to infants born in St. Louis, Mo., Aug. 1957 and subsequently fed for 1 year with fresh cow's milk (St. Louis had the highest reported average concentration of Ba-140 for a 1 year period)	*10-35	* ~ 10-40	* ~ 10-40

*Assuming no more Ba-140 ingested after August 1958.

ited at large distances from the site relatively soon after detonation, usually through the action of rainstorms coincident with a cloud of fresh radioactive debris. This information is shown in Table S-3.

It is estimated that about one sixth of the persons exposed in these hot spot areas received half the average whole body external gamma dose, and one sixth twice the average whole body external gamma dose.

Also shown on Table S-3 is an estimate of the lung and thyroid dose due to inhalation in a single instance of heavy fallout.

There have been many occasions when the dose rate due to fallout has significantly increased the external gamma level from natural background radiation (roughly 100 mrad/year, or 11.4 μrad/hour) at areas far removed from the Nevada Test Site for periods of hours, days or months. For example, readings reported by the Public Health Service indicate 50 μrad/hr at Albany, New York for June 4, 1957, and about 75 μrad/hr at Salt Lake City for August 20 and 21, 1957. A survey by the Health and Safety Laboratory of the Atomic Energy Commission noted that readings of 40 μrad/hr in Brinkley, Arkansas in 1957 had dropped to 10.2 μrad/hr by 1959. During the incident in the Troy-Albany area in 1953, a reading of 10,000 μrad/hr was reported in Troy. Such incidents of temporarily high dose rates were evidently restricted in area and duration, and are not believed to have resulted in any significant change in the average exposure for the whole country for a period of time as long as one year. However, as noted below, the relatively heavy fallout over the entire northern hemisphere in the spring of 1959 does appear to have had a significant effect on the average exposure of the U. S. for the calendar year 1959.

According to the soil measurements of Gustafson at the Argonne National Laboratory near Chicago (and presumably representative of fallout at this latitude), six fission products (Zr^{95}, Cs^{137}, Ru^{106}, Ru^{103}, Ce^{141}, and Ce^{144}) gave rise to an open field dose rate of 8.5 μrad/hr for the month of May 1959. This is 75 percent of the average whole body dose rate from natural background radiation (external and internal). The data also indicate an open field dose rate for the United States of 71 percent of average natural background for the 3 months period beginning in April 1959, and 48 percent of average natural background for the calendar year 1959.

Gustafson suggests that the dose which would be delivered in an open field should be reduced by a factor of 4 to 5 in determining the average exposure of the population to account for the shielding effect of buildings. With such a reduction, the average external gamma dose from fallout for persons in the United States during 1959 becomes 10-12 mrad. Adding to this an average whole body dose of 1-2 mrad from internally deposited Cesium 137, one obtains an average whole body dose for this year of from 11

TABLE S-3

WHOLE BODY EXTERNAL GAMMA DOSES TO PEOPLE RESULTING FROM SPECIFIC INSTANCES OF HEAVY FALLOUT AT LARGE DISTANCES FROM THE NEVADA TEST SITE		
Location	Date of fallout	Computed dose from time of fallout to 1 year thereafter, assuming an overall reduction of 5-10 from the infinite plane dose
Jefferson City, Mo.	July 9-10, 1957	1-2 mrad
North Dakota	July 16, 1957	4-8 mrad
Troy, N. Y.	April 26, 1953	7-14 mrad
Salt Lake City, Utah	March 24, 1953	4-8 mrad
INHALATION DOSE TO THE LUNGS AND THYROIDS RESULTING FROM A SPECIFIC INSTANCE OF HEAVY FALLOUT		
Location	Date of fallout	Calculated dose from short-lived isotopes
St. George, Utah (130 miles from Nevada Test Site)	May 19-20, 1953	230 mrem to lungs (from gross fission product) 280 mrem to thyroid (from iodine)

168<

to 14 percent that of average natural background. Perhaps 1/6th of the population would receive half, and 1/6th twice this average dose.

In this paper (for example in Table S-3) a reduction factor of from 5 to 10 has been applied to take into account the extent to which the average external gamma dose to the population from fallout is reduced by terrain roughness, weathering, and the shielding effect of buildings from what it would be if all the fallout were deposited on a flat, impenetrable plane, and a person remained continously exposed at 3 feet above the surface of that plane. This is roughly compatible with Gustafson's reduction factor of from 4 to 5 between the open field dose and the actual average dose to the population. The open field dose rate is estimated to be about three quarters of the calculated infinite plane dose rate for a month or so after deposition. For a period of several years thereafter it is assumed than an additional reduction factor of two crudely approximates the average additional reduction due to weathering, that is, due to the shielding provided by the earth as the fallout particles gradually make their way down into the soil. It should be emphasized, however, that there is not very satisfactory evidence as to what reduction factors should be applied either to the infinite plane or the open field dose to obtain the average population dose, nor is there very satisfactory information as to what fraction of the population receives external gamma doses appreciably above and below the average.

Some investigations of the biological consequences of fallout have assumed that even a very small exposure to radiation carries with it the probability of producing some biological effect which, although small, is proportional to the dose delivered. We do not discuss the general validity of an assumption of this type, but rather note that it implies that the total number of biological effects of a given kind which are eventually produced in the United States as the result of fallout radiation would be proportional to the sum of all the individual exposures. To evaluate the contribution of hot spots to the total number of biological effects in the United States according to this hypothesis, it would be necessary to compare the sum of the reported exposures in a given hot spot area, and in all of them put together, with the corresponding sum for the United States as a whole.

Since 1951 there have been 74 reported above ground nuclear tests in Nevada, with a cumulative fission yield of about 1 megaton. It is not known how this debris has been deposited around the United States, what times in transit should be associated with its arrival from the various shots, or how many persons might have been exposed in areas where the open field gamma dose was significantly above the average. Crude calculations based on strontium-90 levels and assumed arrival times suggest that the external gamma dose from Nevada may exceed that from the world-wide fallout over many areas of the U. S. and that some significant fraction of the population—perhaps 10 million people—received an additional 100 mrad external gamma radiation from this source. A comparison is made in Table S-4 of the contribution of the Nevada Test Site to the sum of all individual U. S. exposures to external gamma radiation from nuclear testing to date. Since the numbers are so uncertain, one must draw conclusions with care. It does seem reasonable to conclude, however, that the location with the highest individual whole body, external gamma exposures, namely the area immediately surrounding the Nevada Test Site, contributes only about 1 percent of the total U. S. external gamma exposure from world wide fallout, and that the sum of all individual exposures in the U. S. from Nevada tests is greater than the corresponding sum to persons in the immediate vicinity of the Nevada Test Site. The sum of all individual, whole body, 30 year exposures of the population from fallout is estimated to be less than 4 per cent of the corresponding sum of individual whole body, 30 year exposures from natural background radiation.

Taking short lived isotopes to be those with a half life of 1 year or less, the following conclusions are reached as to their contribution to the average and above average doses from fallout in the United States, their relation to hot spots, and the contribution of hot spots to average and above average doses in the United States.

1. Short Lived Isotopes and Average Whole Body Exposures. Depending on the future contribution of internally deposited cesium to the whole body dose—which as shown in Table S-1 is uncertain within wide limits—short lived activities contribute from about 1/3 to 3/4 of the average 30 year, whole body dose in the United States, from about 1/4 to 2/3 of the average 70 year whole body dose, and over 4/5 of the highest 1 year average whole body dose. Their relative contribution to total population exposure (measured in man rads) is the same as their relative contribution to the average exposure.

2. Short Lived Isotopes and Average Internal Exposures. Both short and long lived isotopes may be taken into the body and concentrated in specific organs so as to produce doses to these organs which are greater than the whole body doses from fallout. As shown in Table S-2, the average 30 and 70 year doses to the bone from the long lived internal emitter strontium-90 are 5 to 10 times greater than the average 30 and 70 year whole body doses from fallout, and the average 30 and 70 year doses to the thyroids of children under 10 are 2 to 4 times greater than their average whole body exposure, although it should be noted that the short lived iodine delivers essentially all its dose within 3 months of the period of active testing rather than over a lifetime.

TABLE S-4.—CONTRIBUTIONS OF WORLD WIDE AND NEVADA TEST SITE FALLOUT TO THE 30 YEAR, WHOLE BODY POPULATION EXPOSURE OF THE UNITED STATES

Population	Description of dose	Total population exposure (man rads)
180,000 persons in area within 200 miles of the Nevada Test Site	Up to 6,000 mrad external gamma dose as shown in Table S-2[1]	90,000
An assumed 10 million persons considerably removed from the Nevada Test Site	100 mrads external gamma dose from Nevada tests[1]	1,000,000
180 million persons in the United States	Average external gamma dose of 50 mrad from world-wide fallout from all tests to date	9,000,000
180 million persons in the United States	Average whole body dose of 5-40 mrad due to internal cesium-137 from world-wide fallout	900,000 - 7,200,000
180 million persons in the United States	Average whole body dose of 3000 mrad due to average natural background radiation, external and internal	540,000,000

[1] There will be an additional whole body exposure due to internal emitters which has not been evaluated here.

3. The Contribution of Short Lived Isotopes to Above Average External Gamma Exposures From Nevada Test Site Fallout. A rough estimate of the extent to which isotopes with half lives shorter than 1 week could have affected external gamma exposures in areas which received repeated depositions of fresh debris from the Nevada Test Site may be made from a schedule of fission product decay rates and integrated doses (Table 1, Appendix II). The decay schedule indicates that fallout which arrives at 6 hours after detonation produces about twice the external gamma dose during the following year as does the same level of fallout (measured, say, in terms of millicuries of strontium 90 per square mile) arriving 2 days after detonation, and 3 times the dose of fallout arriving 1 week after detonation.

4. Hot Spots and Their Effect Upon Average and Above Average Doses. The available data suggests that there are areas in the United States, presumably the dimensions of counties or states, where any or all of the radioactivities in fallout have been deposited in surface concentrations clearly above those in surrounding areas and above the average level for the United States as a whole. The evidence for these "hot spot" areas is reflected by high measurements of gamma or beta activity at various times and in scattered locations, in high concentrations of iodine-131 in some of the milk which has been analyzed, and to a lesser extent, in variations in the strontium-90 content of soils and food products.

Above average, whole body, external gamma doses to segments of the population may be presumed directly related to those geographical areas where the above average fallout occurred, and thyroid doses from radioactive iodine to areas where the milk and food products from the hot spot areas are consumed within 2 weeks after production. Above average concentrations of strontium-90 in individual food products from particular areas, particularly wheat and dairy products, affect the strontium-90 intake of persons wherever the food products are consumed. The variation of individual strontium-90 intake is affected by many other factors than high cumulative levels of strontium-90 in specific geographical areas, however, and the geographical variation does not enter directly into the estimates made here of above average doses to the bone and bone marrow from strontium-90.

The location, size, and population affected by individual hot spots, and the extent to which they alter the total exposure of the population is not known. The available evidence suggests that the estimates of average and total population exposure in the U. S. would not be greatly changed from the ones given if more were known about the size and location of hot spot areas.

A principal reason for interest in hot spot areas is to learn to what extent individuals and small segments of the population may have received doses to the whole body or particular organs which are many times greater than the average from fallout, or appreciably greater than natural background radiation over time periods as short as 1 year. As shown in Table S-2, this has occurred for whole body exposures in the area immediately surrounding the Nevada Test Site, and appears to have occurred to the thyroids of infants who drank fresh milk from the milksheds around several large U. S. cities during the years of active testing at the Nevada Test Site. A discussion of the possibility of other areas with significantly above average exposures may be found in the body of the report.

RADIOLOGICAL HEALTH DATA

MONTHLY REPORT

SEPTEMBER 1960

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

Division of Radiological Health

171<

PREFACE

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned, among other things, primary responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. Within the Department this responsibility has been delegated to the Division of Radiological Health, Public Health Service.

As a step in the discharge of this responsibility, the Public Health Service is publishing ***Radiological Health Data***. This publication is issued monthly, with each third issue (starting July 1960) expanded somewhat into a quarterly report.

The monthly and quarterly reports are reviewed by a Board of Editorial Advisors with representatives from the following Federal agencies:

Department of Health, Education, and Welfare
Atomic Energy Commission
Department of Defense
Department of Commerce
Department of Agriculture

172<

TABLE OF CONTENTS

Page

PREFACE iii

SECTION I.—MILK 1

Public Health Service Milk Monitoring Network 1

Data on Radioactivity in Milk (April 1960) Public Health Service Milk Monitoring Program 3

Strontium-90 in Canadian Dried Milk Products 5

Strontium-90 Content of Canadian Dried Milk Powder Samples (January, February, and March 1960)—Department of National Health and Welfare, Ottawa, Canada 7

Strontium-90 Content of Canadian Dried Skim Milk and Dried Buttermilk Samples—Department of National Health and Welfare, Ottawa, Canada 8

SECTION II.—AIR 20

Public Health Service Radiation Surveillance Network 20

Data on Radioactivity of Particulates in Air—Gross Beta Counts (April 1960)—Public Health Service Radiation Surveillance Network 22

Data on Radon and Thoron Air Measurements at Cincinnati, Ohio (April 1960)—Public Health Service Radiation Surveillance Network 23

Data on Radioactivity in Air (May 1960)—U. S. Naval Research Laboratory 23

SECTION III.—WATER 27

Public Health Service National Water Quality Network 27

Data on Radioactivity in Raw Surface Waters (March 1960)—Public Health Service National Water Quality Network 29

Monitoring of Water Supplies Around the Nevada Test Site (January-February 1960, and March-April 1960)—Public Health Service 31

SECTION IV.—OTHER DATA 34

External Gamma:

Data on External Gamma Activity (April 1960)—Public Health Service Radiation Surveillance Network 34

Food:

Food Consumption of Households in the Northeast and North Central Regions of the United States (1955)—U. S. Department of Agriculture 35

Analytical Reference Service:

Analytical Reference Service—Public Health Service Robert A. Taft Sanitary Engineering Center 54

LIST OF TABLES

I-IV.—Data on Radioactivity in Milk (April 1960)—Public Health Service Milk Monitoring Program 3

V.—Strontium-90 Content of Canadian Dried Milk Powder Samples (January, February and March 1960)—Department of National Health and Welfare, Ottawa, Canada 7

VI.—Radioactivity of Particulates in Air—Gross Beta Counts (April 1960)—Public Health Service Radiation Surveillance Network 22

LIST OF TABLES—Con.

Page
VII.—Radon and Thoron Air Measurements (April 1960)—Public Health Service Radiation Surveillance Network 23
VIII.—Daily Record of Fission Product β-Activity Collected by Air Filtration (May 1960)—U. S. Naval Research Laboratory 24
IX.—Radioactivity in Raw Surface Waters (March 1960)—Public Health Service National Water Quality Network 29
X.—Water Sampling Points Around the Nevada Test Site—Public Health Service 31
XI.—External Gamma Activity (April 1960)—Public Health Service Radiation Surveillance Network 34
XII.—Food Consumption Per Person in Households in the Northeast Region of the United States (1955)—U. S. Department of Agriculture 38
XIII.—Food Consumption Per Person in Households in the North Central Region of the United States (1955)—U. S. Department of Agriculture 46

LIST OF FIGURES

1.—Milk Sampling Stations in Canada—Department of National Health and Welfare, Ottawa Canada 6
2.—Strontium-90 Content of Canadian Dried Skim Milk Samples (January 1956 through December 1956)—Department of National Health and Welfare, Ottawa, Canada 8
3.—Strontium-90 Content of Canadian Dried Skim Milk Samples (January 1957 through December 1957)—Department of National Health and Welfare, Ottawa, Canada 9
4.—Strontium-90 Content of Canadian Dried Skim Milk Samples (January 1958 through December 1958)—Department of National Health and Welfare, Ottawa, Canada 11
5.—Strontium-90 Content of Canadian Dried Skim Milk Powder Samples (January 1959 through December 1959)—Department of National Health and Welfare, Ottawa, Canada 14
6.—Strontium-90 Content of Canadian Dried Buttermilk Samples (January 1957 through December 1957)—Department of National Health and Welfare, Ottawa, Canada 17
7.—Strontium-90 Content of Canadian Dried Buttermilk Samples (January 1958 through December 1958)—Department of National Health and Welfare, Ottawa, Canada 18
8.—Strontium-90 Content of Canadian Dried Buttermilk Powder Samples (January 1959 through December 1959)—Department of National Health and Welfare, Ottawa, Canada 19
9.—Public Health Service Radiation Surveillance Network Sampling Stations 21
10.—Average Measurements of Surface Air at Stations Along the 80th Meridian (West) (May 1960)—U. S. Naval Research Laboratory 26
11.—Public Health Service National Water Quality Network of Sampling Stations 28
12.—Gross Beta Measurements in Water Supplies in Off-site Areas of the Nevada Test Site for January-February 1960—Public Health Service 32
13.—Gross Beta Measurements in Water Supplies in Off-site Areas of the Nevada Test Site for March-April 1960—Public Health Service 33
14.—Food Consumption Survey Regions—U. S. Department of Agriculture 36

174<

SECTION I.—MILK

PUBLIC HEALTH SERVICE MILK MONITORING PROGRAM

The original Public Health Service Milk Monitoring Program consisted of 12 sampling stations. This is now being expanded to about 60 stations. Since the sampling procedures for the original and the added stations are somewhat different, they will be described and reported separately. The Public Health Service Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, conducts the analyses for the original network stations and the Public Health Service Southeastern Radiological Health Facility, Montgomery, Alabama, and the Southwestern Radiological Health Facility, Las Vegas, Nevada, for the added stations.

Original Stations

The initial purpose of establishing this network was in keeping with the normal and continuing program of the Department of Health, Education, and Welfare to determine trends in our changing environment, including measurement of amounts of radioactivity in water, air, milk, and other foods. Milk was the food chosen for initial testing since it is among the most important elements of the diet and is constantly available at all seasons of the year and in all climates. A primary objective of the project was to develop and simplify methods of collection and radiochemical analysis of milk to make them more suitable for larger scale programs.

The selection of the original sampling stations was based on the following criteria:

1. The milk represented in each sample was from a group of farms milking a total of at least 1,000 cows.

2. The number of individual farms was small enough so that collection of collateral field data from each farm was feasible.

3. The milk samples were from a supply that was part of a metropolitan milkshed.

4. The conditions under which the milk was received were such that each sample was representative of the same farms in the production area.

The Overton, Nevada and St. George, Utah milksheds do not fulfill the 1,000 cow minimum requirement but have been included since they are part of the monitoring program around the Nevada Test Site.

One gallon samples are collected once each month and forwarded by air parcel post to the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, for radionuclide analysis. It is estimated that these samples represent 2,000 gallon lots. The concentration of iodine-131, barium-140, and cesium-137 and naturally occurring potassium-40 are all currently being measured when present in the milk by gamma scintillation spectroscopy. Total strontium and strontium-90 are determined following radiochemical separations, and the strontium-90 is calculated by measuring the build-up of the daughter decay product, yttrium-90 (after about a two week wait) using a low background anticoincidence beta counter. The total radioactive strontium is counted in a shielded internal proportional counter with the strontium-89 calculated as the difference.

Publication of the data will normally require a period of about four months after collection due to shipment, processing, decay product build-up, compilation of the data, and inclusion with other radiation data in the monthly reports.

A description of the program appears in "The Occurrence of Strontium-90, Iodine-131 and Other Radionuclides in Milk, May 1957 through April 1958," by J. E. Campbell, G. K. Murthy, A. S. Goldin, H. B. Robinson, C. P. Straub, F. J. Weber, and K. H. Lewis, American Journal of Public Health, Vol. 49, No. 2, Feb. 1959, American Public Health Association, reprinted by the Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959.

Previous issues of Radiological Health Data list references for technical descriptions of the methodology of analyses used.

Table I presents the results of analyses for the original stations for April 1960.

Added Stations

The Milk Monitoring Program is being expanded for the primary purpose of providing additional information on levels of radiation in milk consumed by the public. The new stations are being established in cooperation with State and local health and milk sanitation agencies. The cities have been selected in order to provide adequate coverage from the combined viewpoints of production areas and consuming population. The emphasis on this expanded sampling and radioassay program is that of:

1. Measuring the radioactivity levels of the milk consumed by the public in various regions of the country by obtaining samples of pasteurized and homogenized milk at the point of distribution to the public.

2. Providing one sampling point within each state with additional points when indicated by widely varying conditions of the milk supply or the need to provide coverage of large population groups. This differs from the original set of sampling stations whose selection was based principally upon certain criteria involving the milk production and milkshed area characteristics (see page 1).

In some instances the designated points are the same as those which reported originally. The establishment of the added sampling stations does not preclude the need for further samples from the selected milksheds serving the same cities. It is important that both networks be in operation for a sufficient period of time to provide an overlap for purposes of comparative study.

The sampling procedure has been developed to give a sample from one day's sales per month in a community which will be as representative of the total supply as can be achieved under practical conditions. The sample will be a composite of those plants supplying not less than 90% of the city's milk supply. The contribution from each plant to the total sample will be approximately proportional to volume of milk sold.

The samples from the added stations are collected with the assistance of the various State and local health and milk sanitation agencies and shipped for analysis to either the Southwestern or Southeastern Radiological Health Facility. The Southeastern Radiological Health Facility processes samples from the 30 states east of the Mississippi, and the Southwestern Radiological Health Facility from the States generally west of the Mississippi River.

At the present time radioassays for Sr^{90} and Cs^{137} are being performed. As the laboratories increase their capacities and instrumentation, a selected group of radionuclides of concern to public health agencies will be included for assay as necessary for complete monitoring of the milk supply.

The first set of data from the Southeastern Radiological Health Facility for April 1960 is presented in Table II. Tables III and IV present the March and April data from the Southwestern Radiological Health Facility.

TABLE I.—DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Robert A. Taft Sanitary Engineering Center

April 1960

(Radioactivity in $\mu\mu c$/liter)

Area	Calcium grams/liter		Iodine-131		Strontium-89		Strontium-90		Barium-140		Cesium-137	
	April	Yearly average	April	Yearly average	April	Yearly average	April	Yearly average	April	Yearly average	April	Yearly average
Atlanta, Ga.	1.11	1.15	0	5	0	16	15.8	16.4	0	0	55	74
Austin, Tex.	1.12	1.11	0	3	0	7	4.4	5.6	0	0	15	36
Chicago, Ill.	1.18	1.10	0	0	0	10	9.4	9.6	0	0	50	49
Cincinnati, Ohio	1.19	1.12	0	<1	0	10	13.5	12.5	0	0	35	42
New York, N. Y.	1.19	1.08	0	1	0	6	10.2	10.4	0	0	45	48
Overton, Nev.	1.18	1.08	0	0	0	1	2.6	3.3	0	0	5	25
Sacramento, Calif.	1.08	1.09	0	0	0	4	4.6	4.2	0	0	10	32
Salt Lake City, Utah	1.09	1.10	0	1	0	6	7.0	7.7	0	0	55	48
Spokane, Wash.	1.05	1.14	0	2	0	17	14.9	13.6	0	0	60	66
St. George, Utah			No sample collected									
St. Louis, Mo.	1.16	1.25	0	0	0	24	23.4	21.1	0	0	40	66

Samples are taken at one sampling point from the milk supply of the areas listed above.

TABLE II.—DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Southeastern Radiological Health Facility

April 1960

(Radioactivity in μμc/liter)

Area	Calcium grams/liter		Strontium-90		Cesium-137	
	April	Average to date*	April	Average to date*	April	Average to date*
Burlington, Vt.	1.22	-	12	-	18	-
Charleston, W. Va.	1.13	-	9	-	<10	-
Hartford, Conn.	1.21	-	8	-	<10	-
Louisville, Ky.	1.12	-	5	-	<10	-
Manchester, N. H.	1.36	-	16	-	40	-
Pittsburgh, Pa.	1.23	-	14	-	18	-
Syracuse, N. Y.	1.21	-	6	-	15	-

*April sample is initial sample.

Note: Strontium-89 analysis performed, but no significant amounts detected.

TABLE III.—DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Southwestern Radiological Health Facility

March 1960

(Radioactivity in μμc/liter)

Area	Calcium grams/liter		Strontium-89		Strontium-90		Cesium-137	
	March	Average to date[1]	March	Average to date[1]	March	Average to date[1]	March	Average to date[1]
Albuquerque, N. Mex.	1.2	-	[2] 0	-	2.7	-		
Denver, Colo.	1.1	-	0	-	7.8	-		
Idaho Falls, Idaho	1.1	-	8.9	-	4.0	-		
Las Vegas, Nev.	1.1	-	0	-	2.7	-		
Palmer, Alaska	1.1	-	0	-	5.0	-		
Salt Lake City, Utah	1.2	-	0	-	8.0	-		

[1] March sample is initial sample.

[2] Zero means calculated value is less than twice error at 95% confidence level.

TABLE IV.—DATA ON RADIOACTIVITY IN MILK

Public Health Service Milk Monitoring Program
Southwestern Radiological Health Facility

April 1960

(Radioactivity in μμc/liter)

Area	Calcium grams/liter		Strontium-89		Strontium-90		Cesium-137	
	April	Average to date	April	Average to date	April	Average to date	April	Average to date
Albuquerque, N. Mex.[1]	1.2	1.2	[3]0	0	4.2	3.45		
Denver, Colo.	1.25	1.17	0	0	7.4	7.6		
Honolulu, Hawaii[2]	1.1	-	4.8	-	2.1	-	38	-
Idaho Falls, Idaho[1]	1.0	1.05	0	4.4	6.2	5.1	[2]43	-
Kansas City, Mo.[2]	1.2	-	14.0	-	6.8	-		
Laramie, Wyo.[2]	1.1	-	5.9	-	6.6	-		
Palmer, Alaska[1]	1.1	1.1	0	0	8.0	6.5		
Portland, Oreg.[2]	1.0	-	17.5	-	8.6	-		
Salt Lake City, Utah[1]	1.1	1.15	0	0	10	9.0		
Seattle, Wash.[2]	1.1	-	16.1	-	4.8	-		
Wichita, Kans.[2]	1.2	-	11.8	-	4.6	-		

[1] Average for first two months.
[2] Initial sample.
[3] Zero means calculated value is less than twice error at 95% confidence level.

STRONTIUM 90 IN DRIED CANADIAN MILK PRODUCTS

The following table, No. V, presents the results of measurements of strontium-90 in Canadian dried milk for the months of January, February and March 1960. This table was included in the Quarterly Report, dated June 1960, published by the Radiation Protection Division of the Department of National Health and Welfare, Canada.

Graphs showing the strontium-90 content, covering the period 1956-59, are also included. These are based on data contained in earlier reports published by the Department of National Health and Welfare, Canada.

These data are reproduced in the present form through the permission of the Department of National Health and Welfare, Canada.

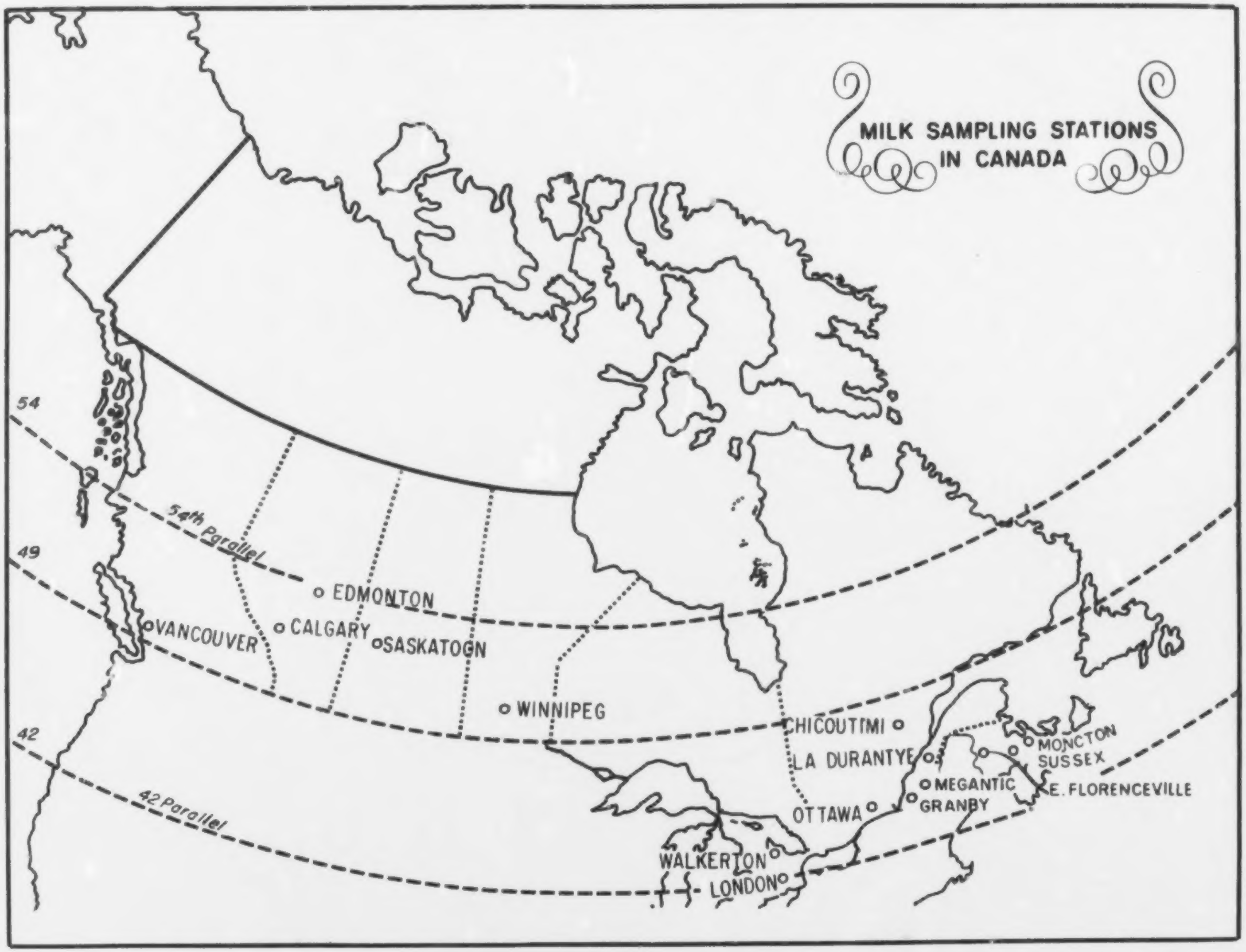

MILK SAMPLING STATIONS
IN CANADA
54
49
42
54th Parallel
42 Parallel
EDMONTON
VANCOUVER
CALGARY
SASKATOON
WINNIPEG
CHICOUTIMI
LA DURANTYE
OTTAWA
MEGANTIC
GRANBY
MONCTON
SUSSEX
E. FLORENCEVILLE
WALKERTON
LONDON

FIGURE 1

TABLE V.—STRONTIUM-90 CONTENT OF CANADIAN DRIED MILK POWDER SAMPLES

Department of National Health and Welfare

(Concentration in Micromicrocuries per gram of Calcium)

Station	1960 January	1960 February	1960 March
Vancouver[1]	17.2	17.6	19.7
Edmonton[1]	16.5	16.6	14.1
Calgary	15.6	15.1	15.0
Saskatoon[2]	10.1	12.1	13.2
Winnipeg[2]	N.S.	N.S.	12.0
Walkerton	5.1	5.6	6.2
London[1]	5.1	6.3	7.5
Ottawa[1]	10.7	10.9	9.8
Granby[1]	20.2	26.8	19.4
Megantic	20.1	23.1	23.4
LaDurantye	19.9	19.5	21.7
Chicoutimi	16.1	19.5	18.1
Moncton[2]	13.6	11.6	13.0
Sussex	18.6	18.6	13.0
East Florenceville	N.S[3].	19.0	15.5
Charlottetown	N.S.	N.S.	N.S.
Average	14.5	15.9	14.7

[1] Natural strontium determinations made for these stations. All other stations were corrected for natural strontium using an average factor of 1.06.

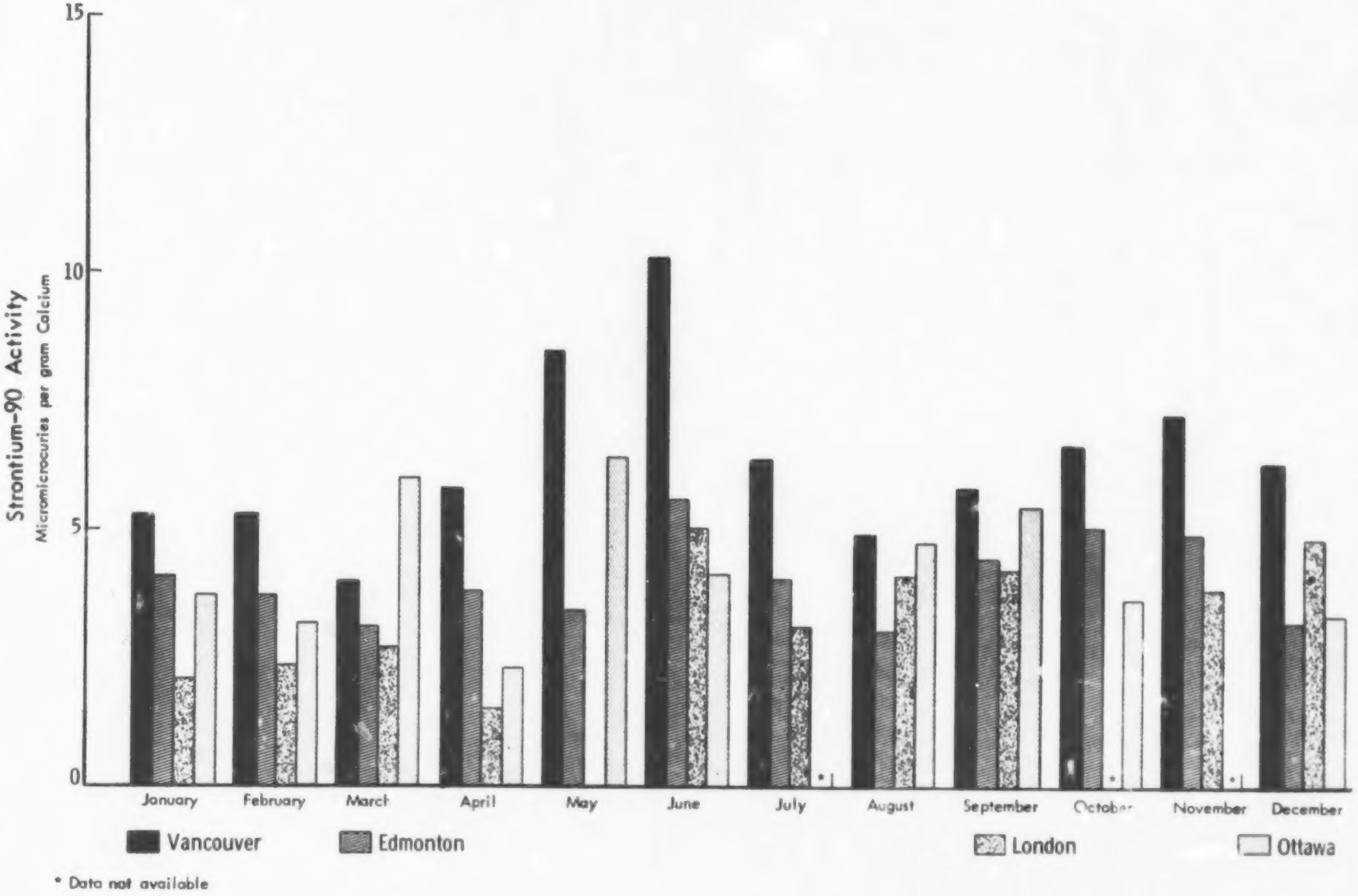
[2] Buttermilk sample. All other samples skim milk.

[3] No milk powder manufactured for the month.

[4] All values are the result of single analyses and each has an error term of an estimated ±6% associated with the analytical method (the contribution due to the method of sampling is not included).

[5] Samples collected by inspectors of the Marketing Division, Department of Agriculture.

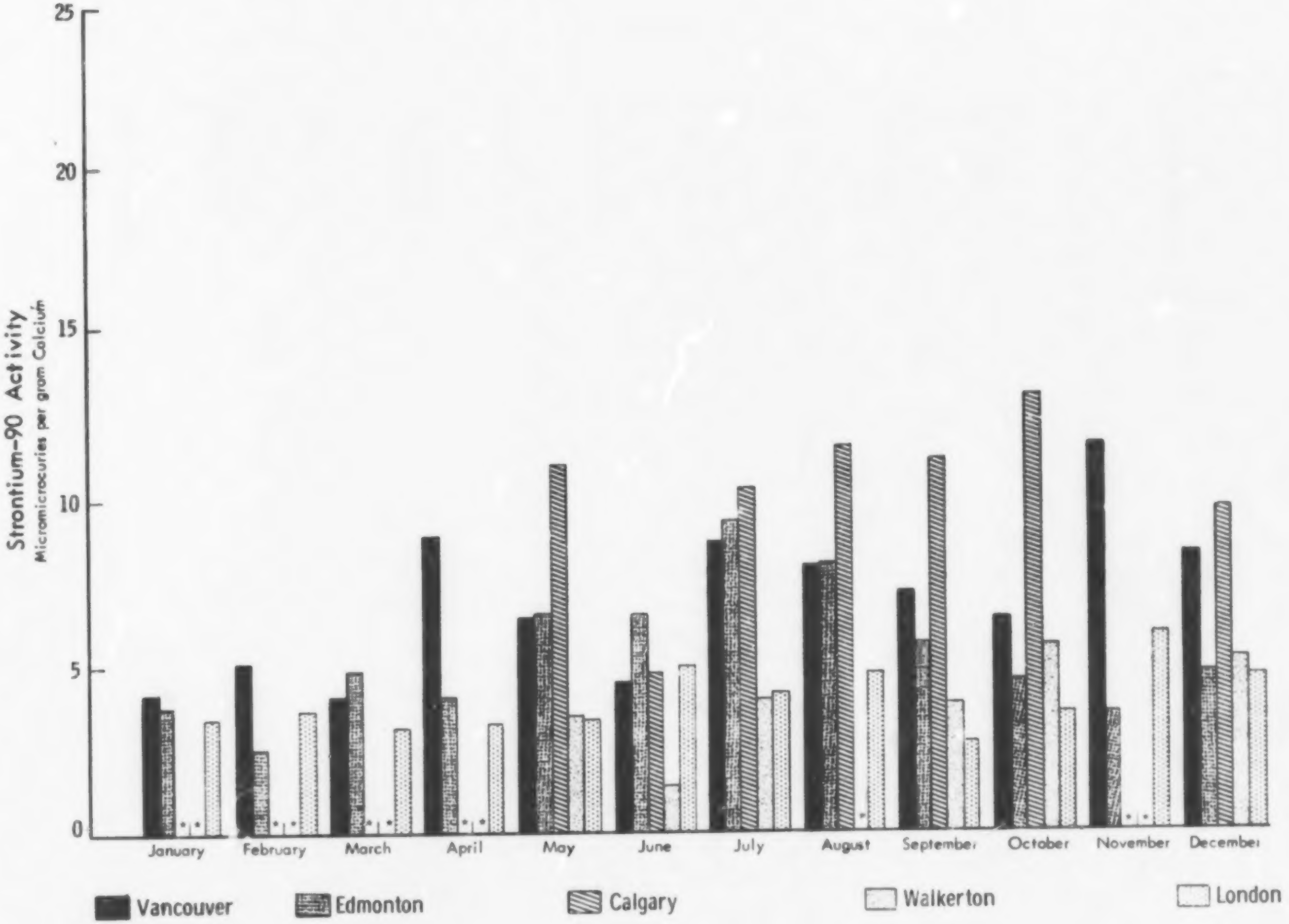
STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK SAMPLES JAN. - DEC. 1956



* Data not available

FIGURE 2

STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK SAMPLES JAN. - DEC. 1957



*Data not available

FIGURE 3a

STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK SAMPLES JAN. - DEC. 1957

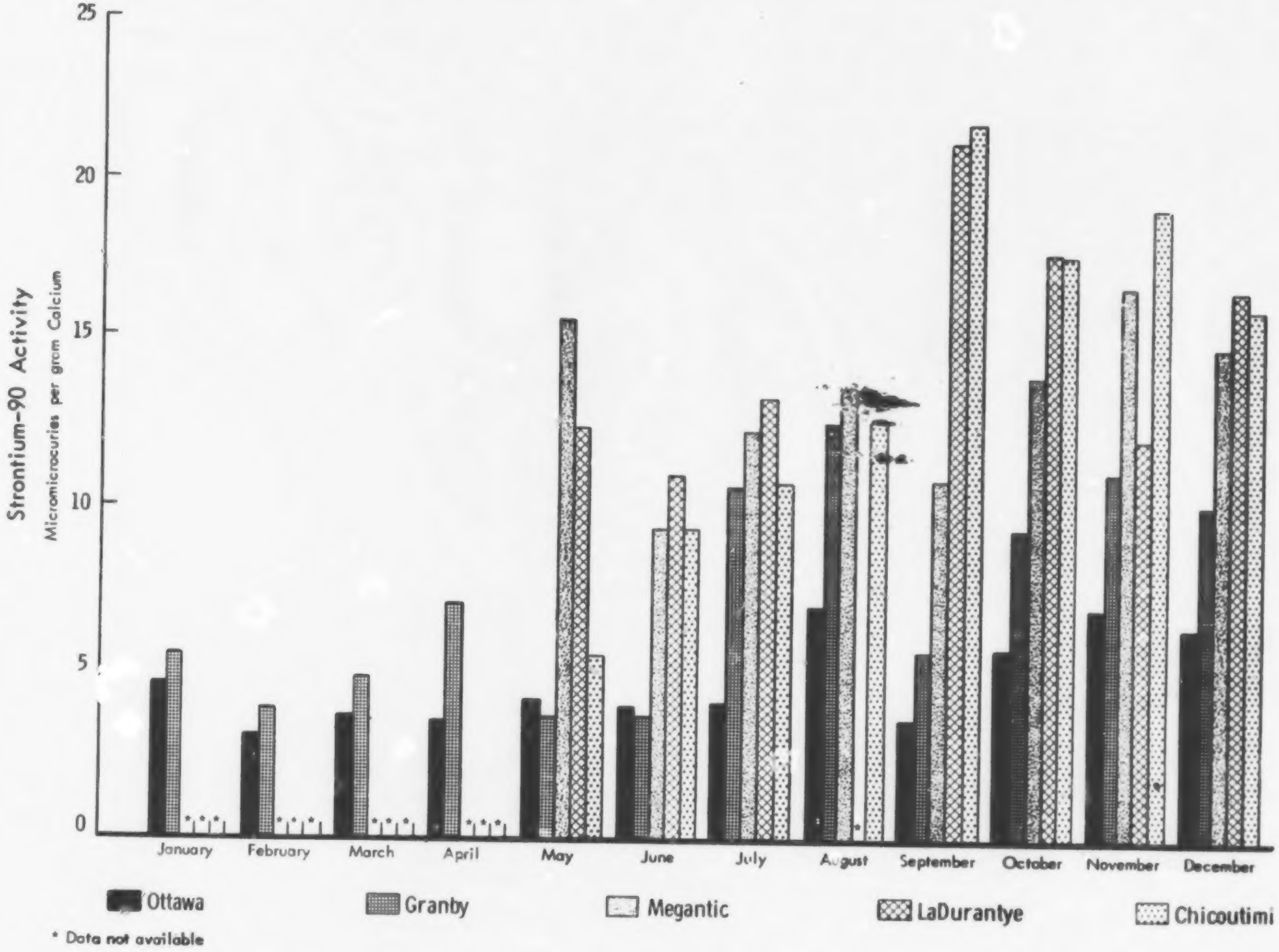


FIGURE 3b

STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK SAMPLES JAN. - DEC. 1958

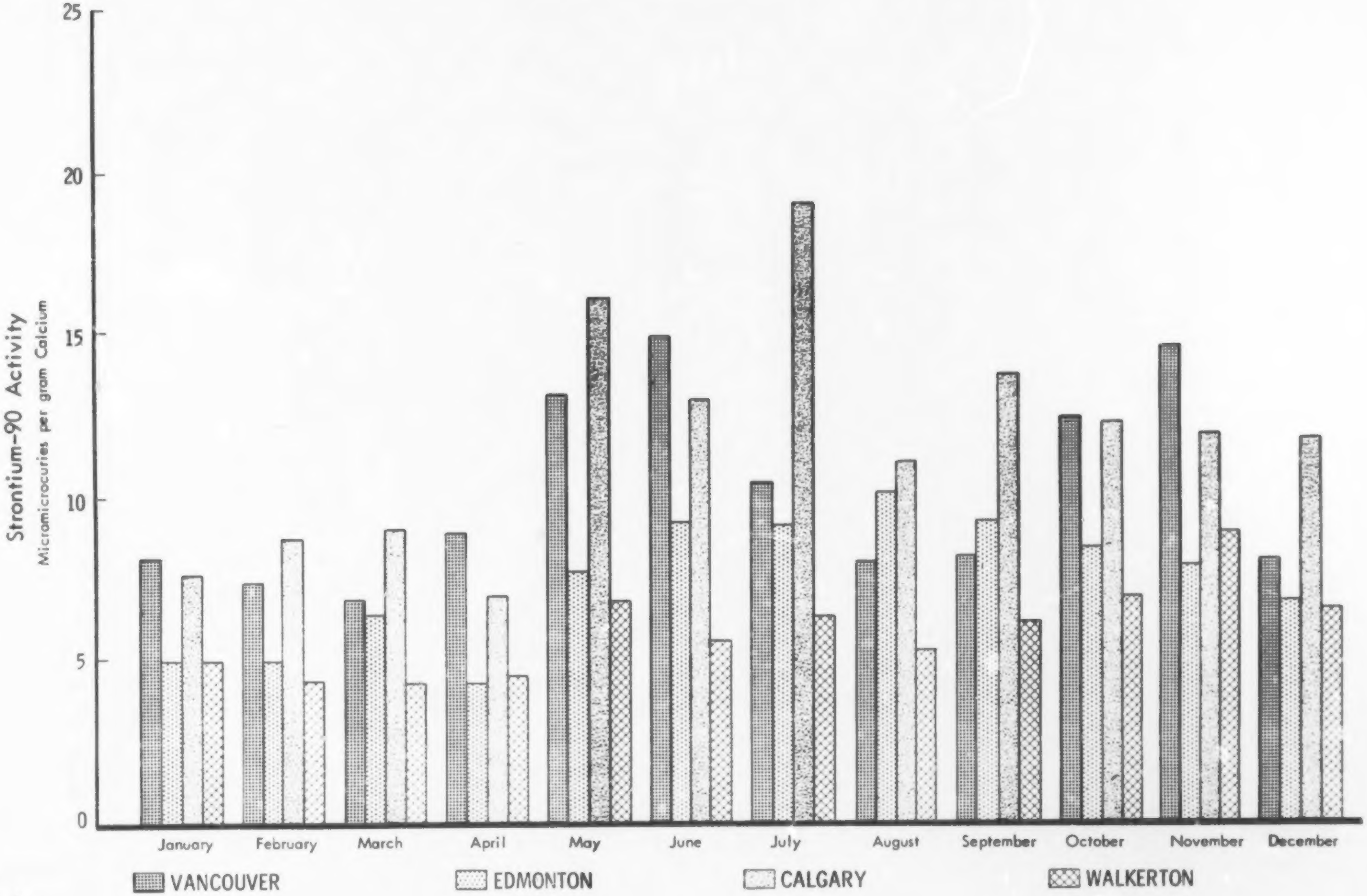


FIGURE 4a

STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK SAMPLES JAN. - DEC. 1958

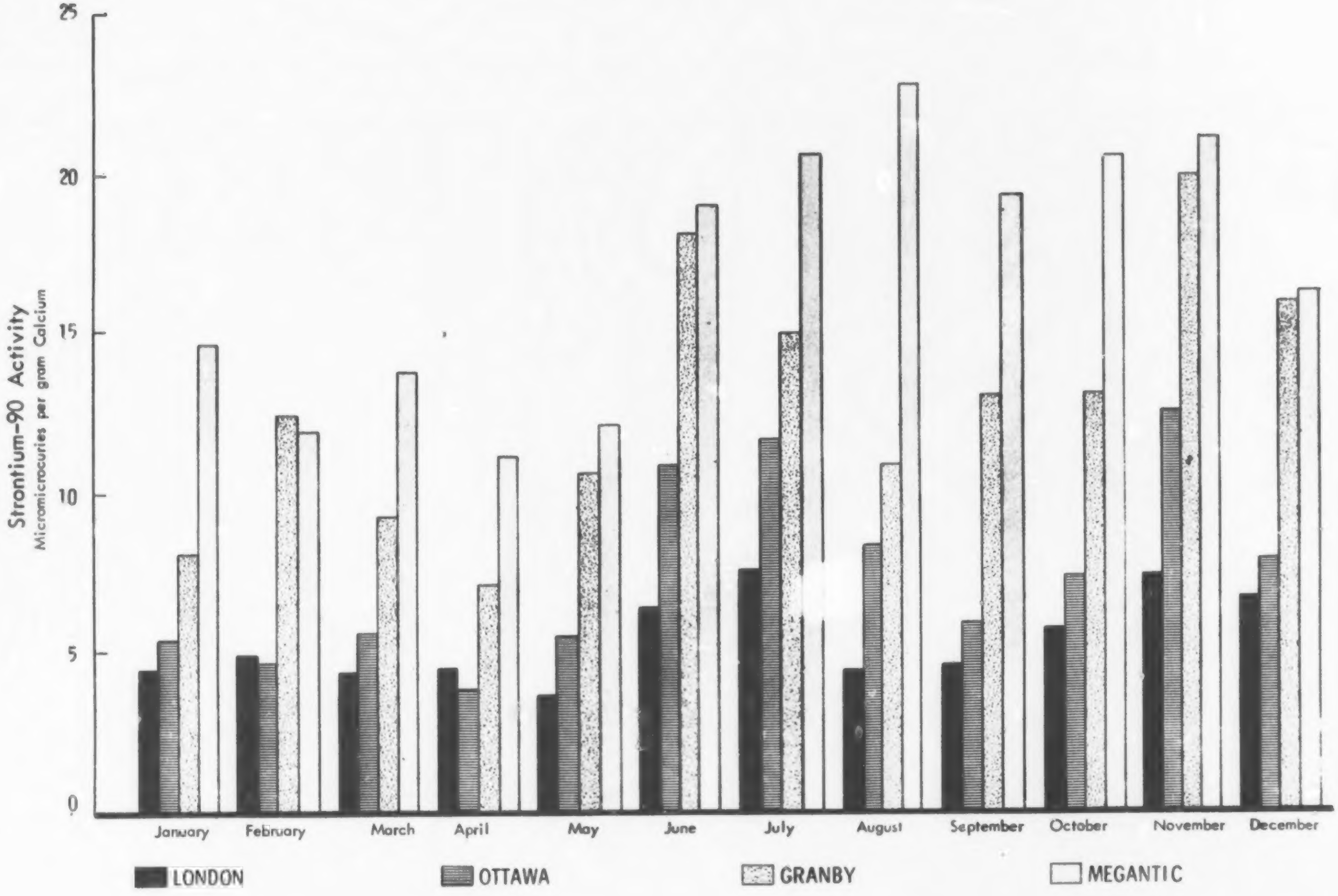
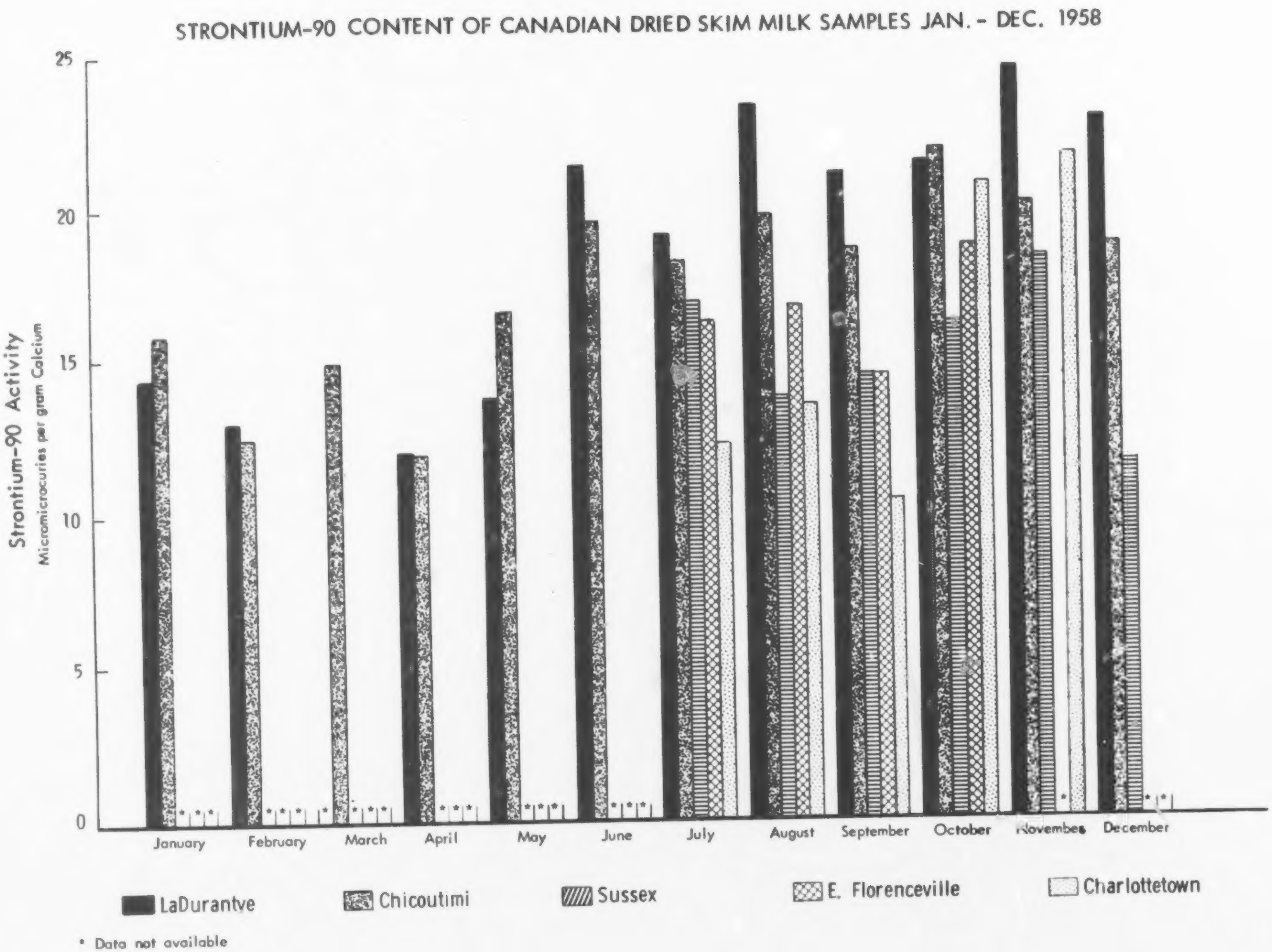


FIGURE 4b



STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK SAMPLES JAN. - DEC. 1958

FIGURE 4c

STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK POWDER SAMPLES JAN. - DEC. 1959

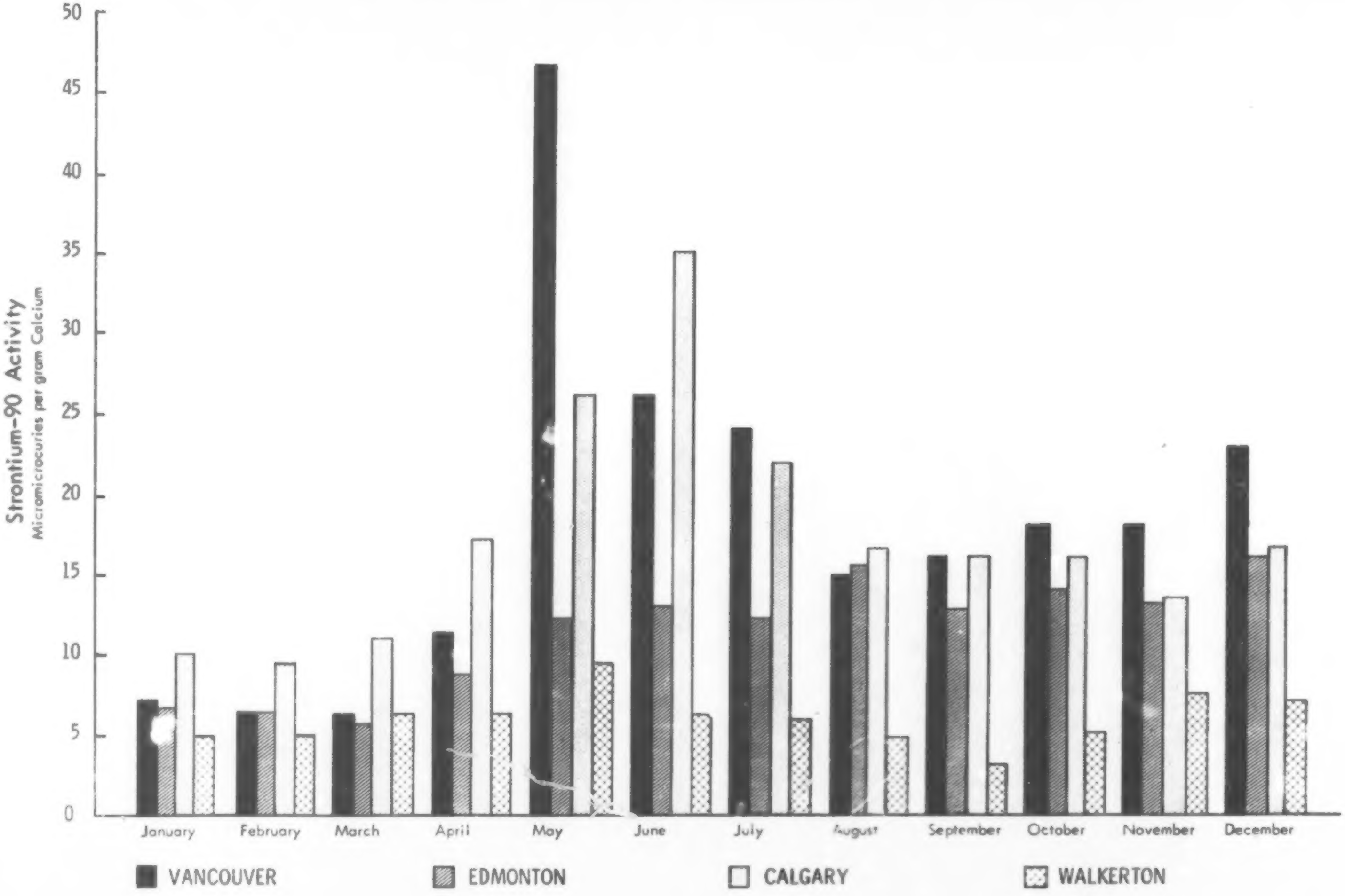
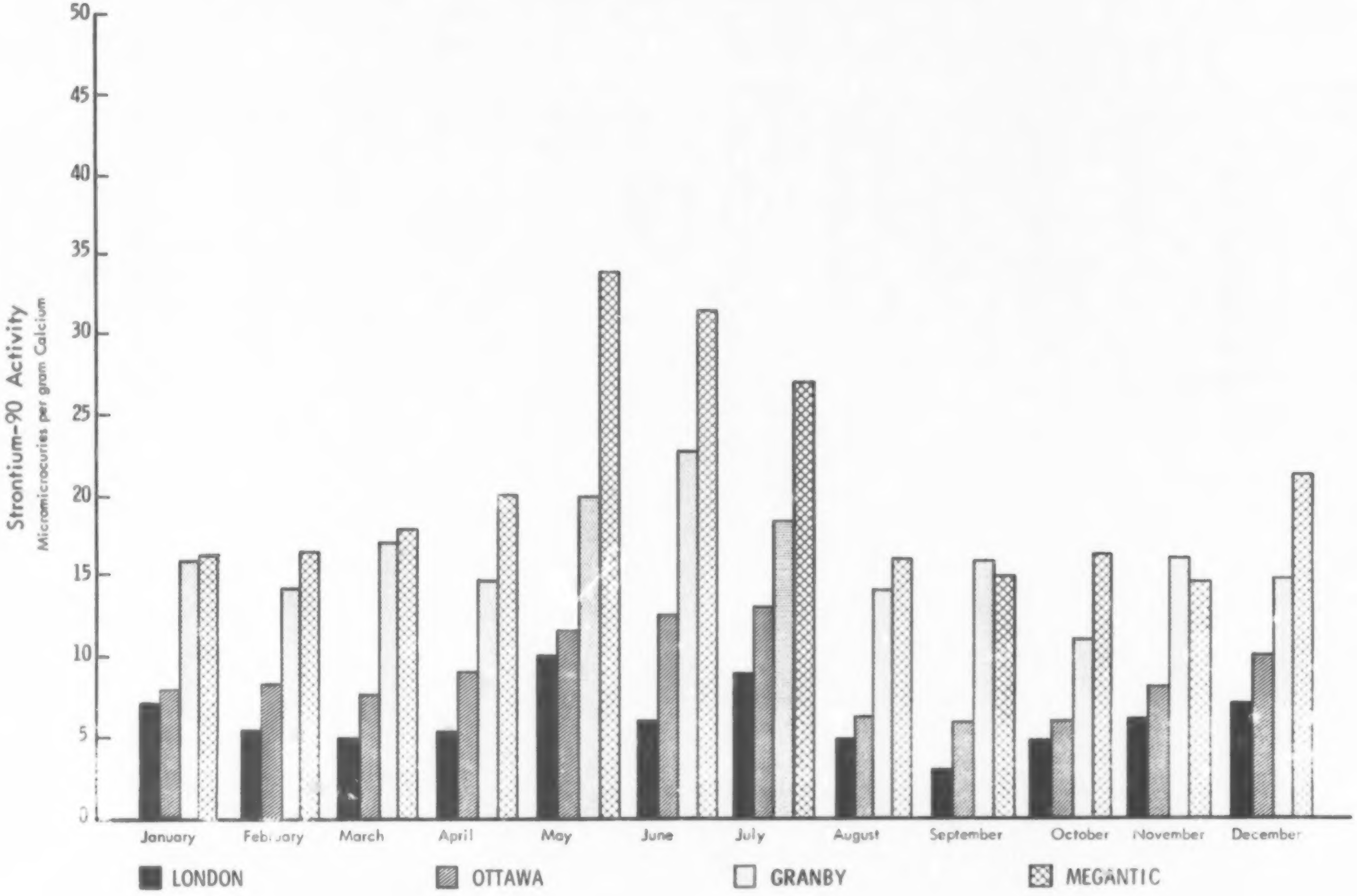


FIGURE 5a

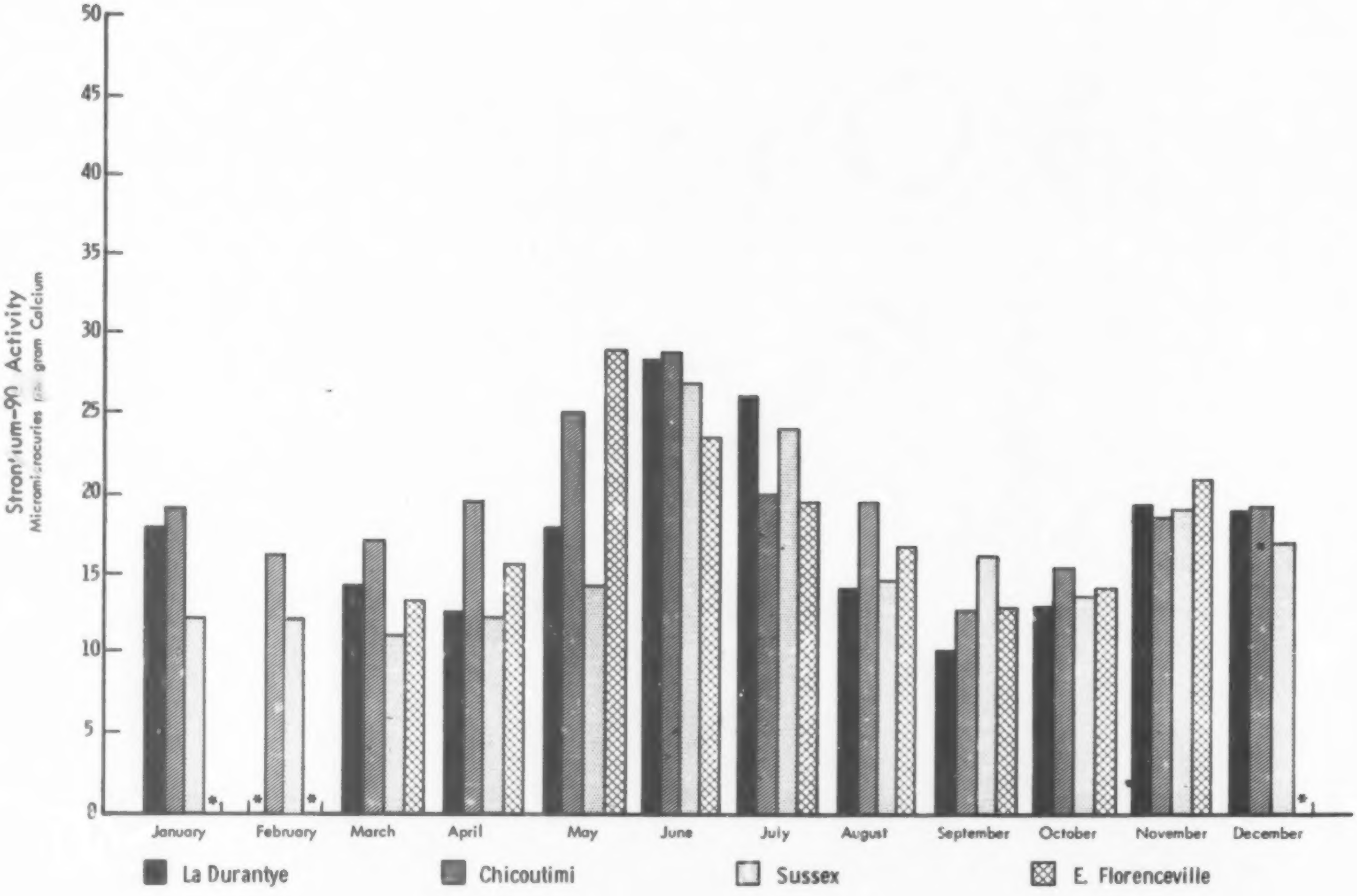
STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK POWDER SAMPLES JAN.-DEC. 1959



* Data not available.

FIGURE 5b

STRONTIUM-90 CONTENT OF CANADIAN DRIED SKIM MILK POWDER SAMPLES JAN.-DEC. 1959



* Data not available.

FIGURE 5c

STRONTIUM-90 CONTENT OF CANADIAN DRIED BUTTERMILK SAMPLES JAN. - DEC. 1957

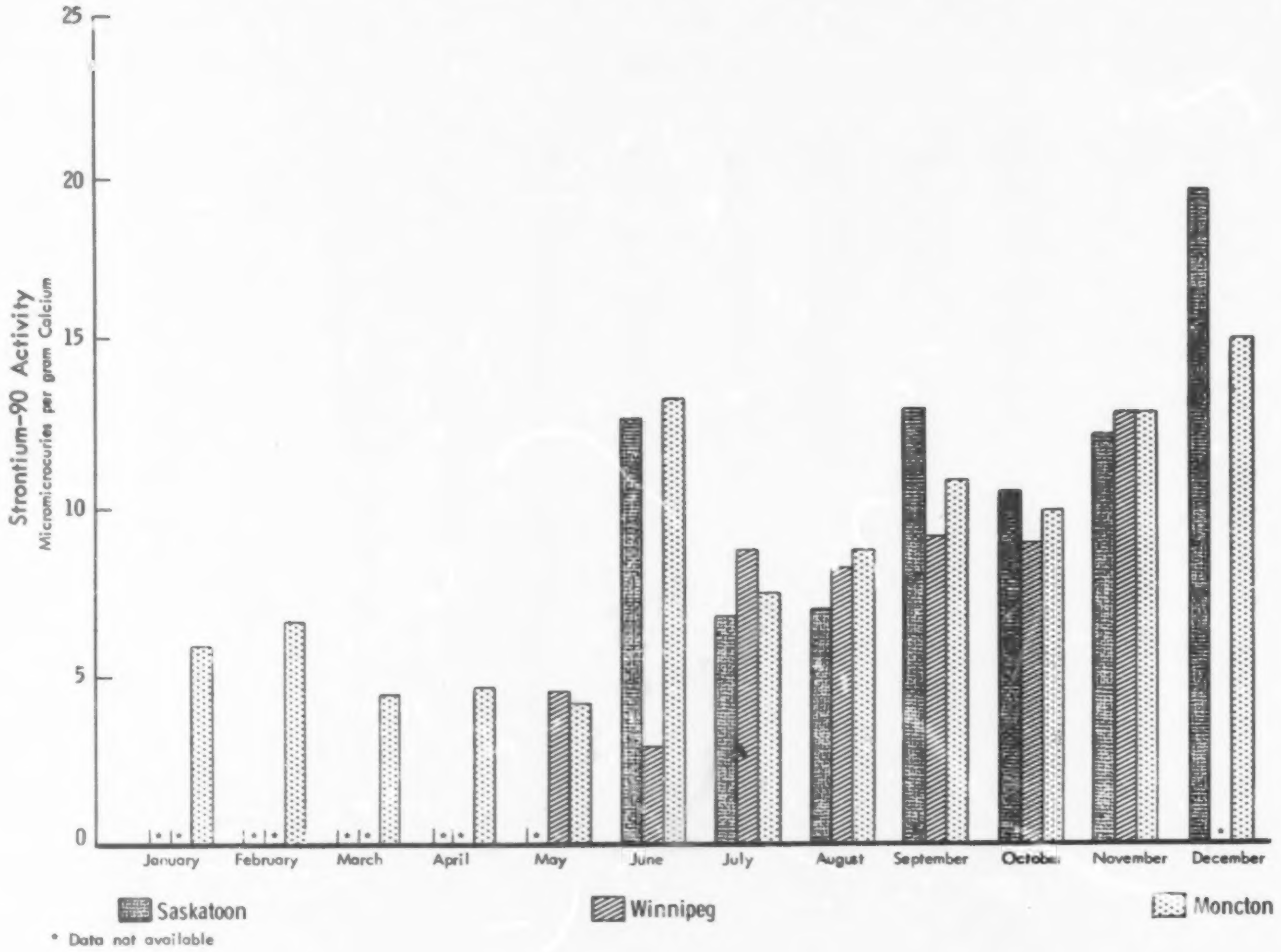
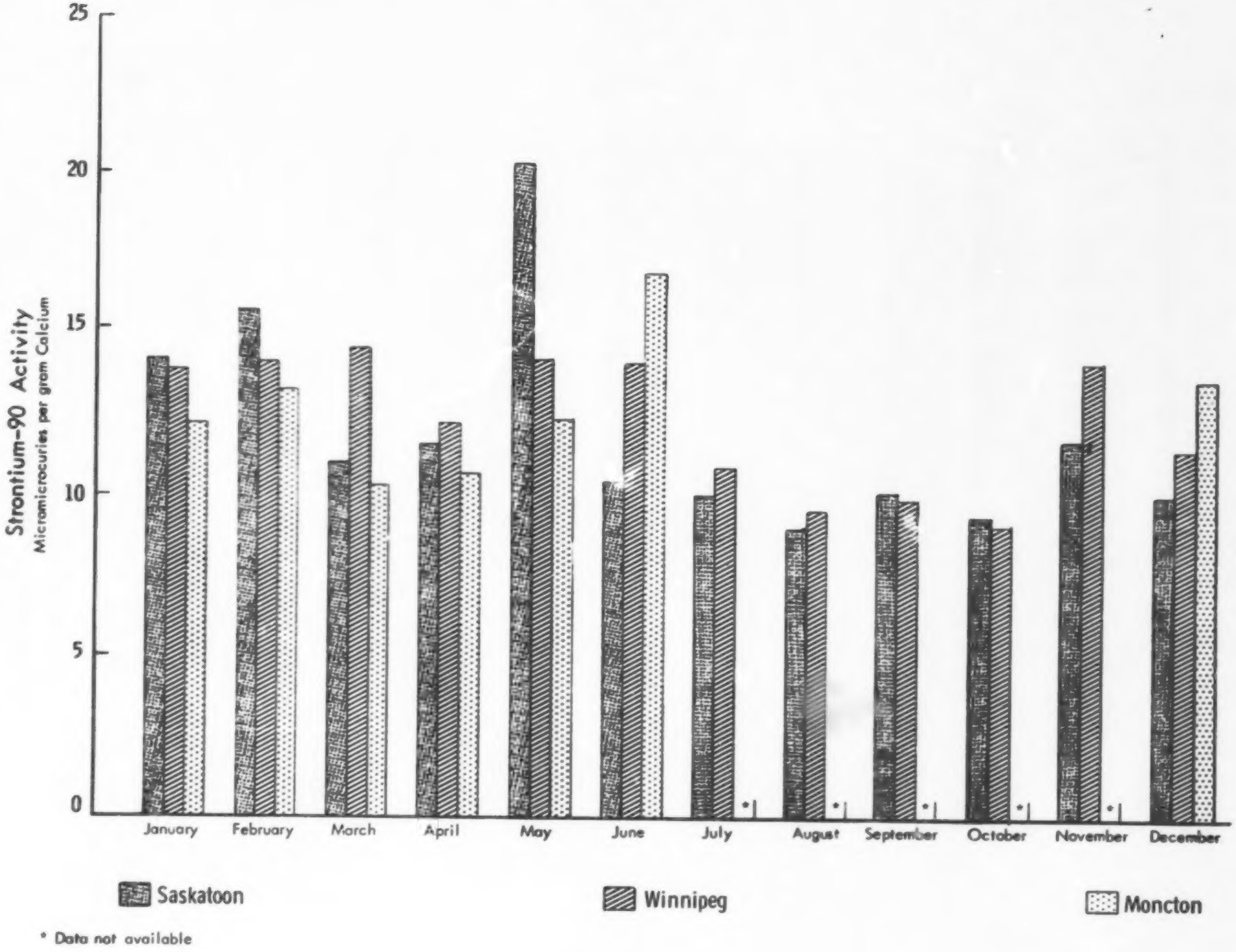


FIGURE 6

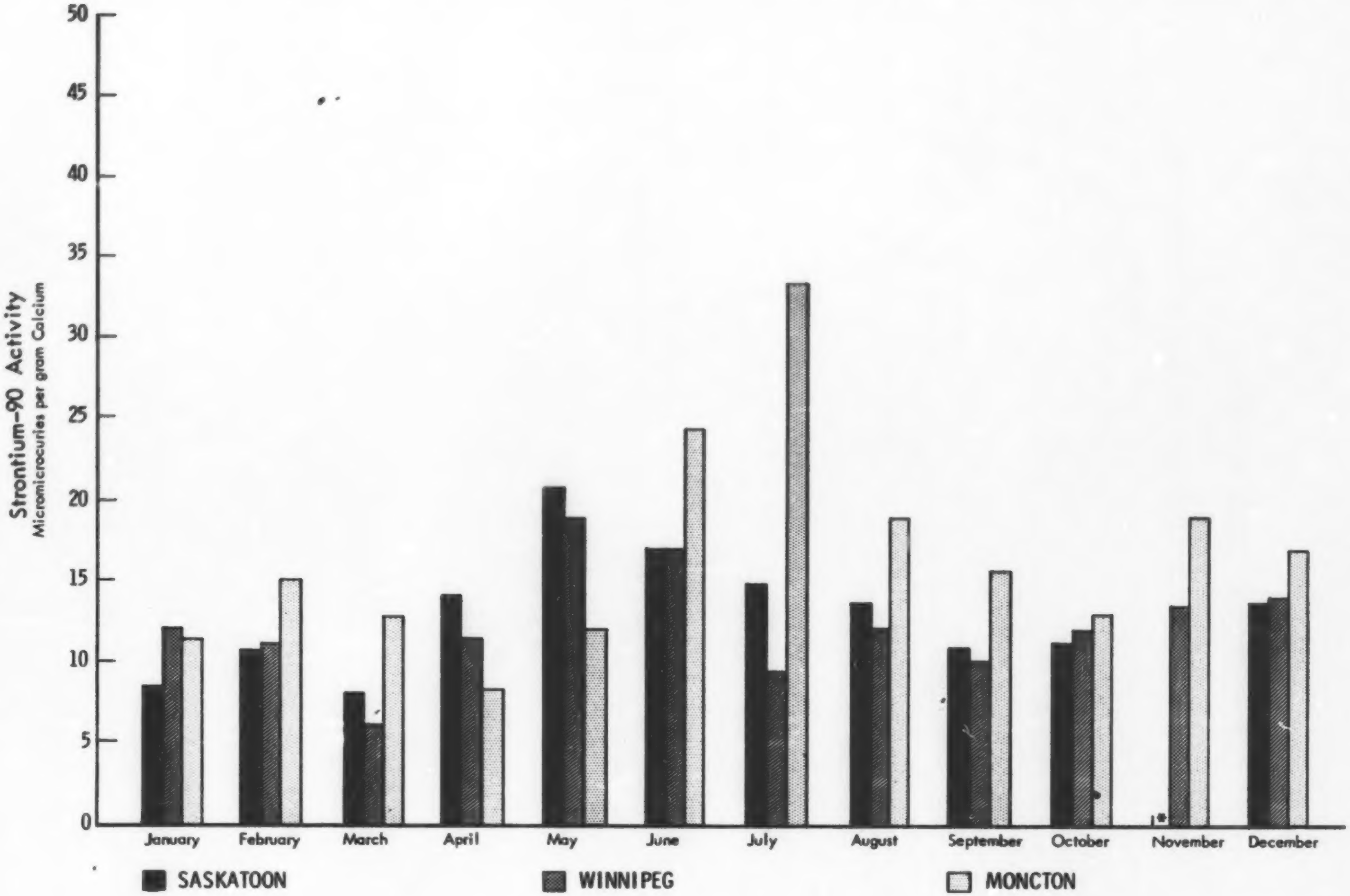
STRONTIUM-90 CONTENT OF CANADIAN DRIED BUTTERMILK SAMPLES JAN. - DEC. 1958



* Data not available

FIGURE 7

STRONTIUM-90 CONTENT OF CANADIAN DRIED BUTTERMILK POWDER SAMPLES JAN.-DEC. 1959



* Data not available.

FIGURE 8

SECTION II.—AIR

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

The Public Health Service Radiation Surveillance Network was established in 1956 in cooperation with the Atomic Energy Commission to provide a means of promptly determining increases in environmental radiation due to radioactive fallout during neclear weapons tests. The program has proven sufficiently valuable that it has been extended to a round-the-year basis and currently consists of 45 stations at urban locations (see figure 1) operated by State and local health department personnel with 2 operated by U. S. Public Health Service personnel.

Measurements of gross beta radioactivity in air have been taken since they provide one of the earliest and most sensitive indications of increases of activity in the environment, and thus act as an "alert" system. A direct evaluation of biological hazards is not possible from these data alone. However, field measurements do enable the operator to estimate the amount of beta activity of particulates in the air at the station five hours after collection, by comparison to a known source, using a portable survey meter. The filters are then forwarded to a laboratory in Washington for a more refined measurement using a thin window proportional counter.

Air samplers are in operation at the 45 stations on an average of 70% of the week. Air is drawn through a cellulose carbon loaded dust filter using a high volume air sampler. The radioactive material in fallout adhering to small dust-like particles is retained on the filter. Some gaseous fission products are adsorbed by the carbon. The contribution by gaseous fission products has represented only a small part of the total beta activity in these samples.

About 85% of the stations collect samples of precipitation which are sent to Washington for analysis. Values are now below limits of detection by present instrumentation. New equipment is being procured to measure lower values. Measurements have indicated that the bulk of deposited activity occurs through precipitation but concentrations in surface air are not directly relatable to the amount deposited through precipitation.

Table VI presents a summary of the latest monthly data.

194

PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

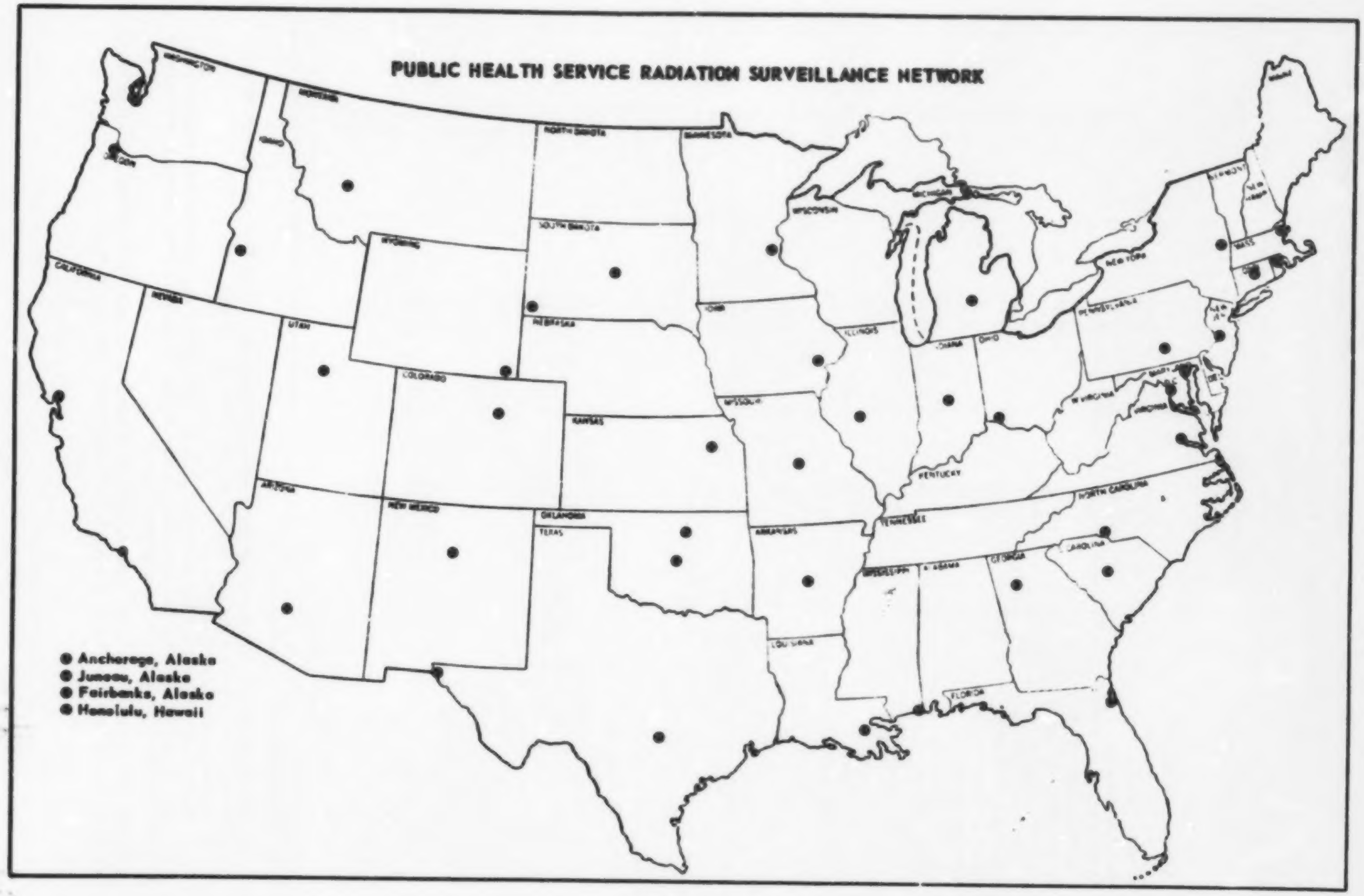

WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SO. CAROLINA
NORTH CAROLINA
VIRGINIA
W. VIRGINIA
MARYLAND
PENNSYLVANIA
NEW YORK
NEW JERSEY
VERMONT
NEW HAMP.
MASS.
MAINE
● Anchorage, Alaska
● Juneau, Alaska
● Fairbanks, Alaska
● Honolulu, Hawaii

FIGURE 9

TABLE VI.--RADIOACTIVITY OF PARTICULATES IN AIR--GROSS BETA COUNTS

Public Health Service Radiation Surveillance Network

April 1960

Station location	Weighted averages $\mu\mu c/M^3$	Maximum $\mu\mu c/M^3$	Minimum $\mu\mu c/M^3$
Alaska, Anchorage	< 0.14	0.24	< 0.10
Alaska, Fairbanks	< 0.14	0.19	< 0.10
Alaska, Juneau	< 0.13	0.30	< 0.10
Arizona, Phoenix	0.31	0.40	0.19
Arkansas, Little Rock	0.21	0.32	0.13
California, Berkeley	< 0.12	0.21	< 0.10
California, Los Angeles	< 0.18	0.39	< 0.10
Colorado, Denver	< 0.26	0.56	< 0.10
Connecticut, Hartford	< 0.15	0.32	< 0.10
District of Columbia	< 0.23	0.44	< 0.10
Florida, Jacksonville	< 0.19	0.31	< 0.10
Georgia, Atlanta	< 0.23	0.32	< 0.10
Hawaii, Honolulu	< 0.14	0.25	< 0.10
Idaho, Boise	0.28	0.41	0.20
Illinois, Springfield	< 0.25	0.45	< 0.10
Indiana, Indianapolis	< 0.19	0.39	< 0.10
Iowa, Iowa City	< 0.16	0.28	< 0.10
Kansas, Topeka	< 0.20	0.50	< 0.10
Louisiana, New Orleans	0.21	0.27	0.12
Maryland, Baltimore	< 0.20	0.35	< 0.10
Massachusetts, Lawrence	< 0.12	0.17	< 0.10
Michigan, Lansing	< 0.18	0.43	< 0.10
Minnesota, Minneapolis	< 0.16	0.21	< 0.10
Mississippi, Pascagoula	0.22	0.51	0.14
Missouri, Jefferson City	< 0.19	0.36	< 0.10
Montana, Helena	< 0.15	0.25	< 0.10
New Jersey, Trenton	< 0.16	0.30	< 0.10
New Mexico, Santa Fe	0.33	0.57	0.18
New York, Albany	< 0.15	0.33	< 0.10
North Carolina, Gastonia	< 0.26	0.39	< 0.10
Ohio, Cincinnati	1.12	3.30	0.20
Oklahoma, Oklahoma City	0.26	0.49	0.13
Oklahoma, Ponca City	< 0.11	0.23	< 0.10
Oregon, Portland	< 0.16	0.35	< 0.10
Pennsylvania, Harrisburg	< 0.25	0.46	< 0.10
Rhode Island, Providence	< 0.16	0.34	< 0.10
South Carolina, Columbia	< 0.20	0.39	< 0.10
South Dakota, Edgemont	0.32	0.53	0.14
South Dakota, Pierre	< 0.23	0.37	< 0.10
Texas, Austin	< 0.18	0.33	< 0.10
Texas, El Paso	0.31	0.50	0.14
Utah, Salt Lake City	< 0.20	0.34	< 0.10
Virginia, Richmond	< 0.16	0.25	< 0.10
Washington, Seattle	< 0.10	0.13	< 0.10
Wyoming, Cheyenne	0.21	0.29	0.13

Values for beta activities in air in Cincinnati are somewhat higher than in other stations in the Radiation Surveillance Network. Reasons may be:

1. Cincinnati uses a membrane type filter with a 20 liters per minute flow rate, compared to a cellulose type filter at other stations sampling 1,500 liters per minute.
2. Variations in counting equipment.
3. Samples are counted at Cincinnati within one day after collection, whereas the samples from other stations are counted several days later in Washington. Thus, Cincinnati values may incorporate natural beta activity from thoron daughters.

Although the relative contribution from each of these parameters has yet to be evaluated, it is recognized that some of them probably play a much more significant role than others.

TABLE VII.—RADON AND THORON AIR MEASUREMENTS

Public Health Service Radiation Surveillance Network
Cincinnati, Ohio

April 1960

Date	Continuous sample collection			Radon$^{(a)}$ AM $\mu\mu$c/M^3	Radon$^{(b)}$ PM $\mu\mu$c/M^3	Thoron$^{(c)}$ $\mu\mu$c/M^3	Beta$^{(d)}$ activity $\mu\mu$c/M^3
	Sample change time	Sampling period (hours)	Volume M^3				
April 1	0806	23.9	27.5	123	82	1.8	0.4 (3)
4	0819	72.1	83.9	127	62	1.9	0.3
5	0812	23.9	28.0	51	46	0.9	0.5
6	0810	23.9	28.0	150	60	2.0	0.9
7	0810	23.8	27.4	237	47	2.2	0.9
8	0830	24.3	28.4	96	40	2.1	0.3 (3)
11	0808	71.5	84.5	262	89	4.5	0.6
12	0815	24.0	25.2	204	26	3.2	1.0
13	0815	23.9	27.0	746	75	9.4	3.3
14	0803	23.7	27.4	201	59	3.4	1.3
15	0808	24.0	27.6	298	66	4.8	0.3 (3)
18	0810	71.9	84.1	91	42	2.5	0.6
19	0803	23.8	28.0	268	36	4.9	1.6
20	0810	24.0	28.4	634	80	9.0	2.9
21	0807	23.9	28.0	121	57	2.9	1.6
22	0810	23.9	28.1	538	97	4.6	0.2 (3)
25	0812	72.0	84.2	970	84	13.7	1.8
26	0805	23.8	28.0	698	77	8.2	2.9
27	0810	24.0	28.4	294	107	5.4	1.7
28	0806	23.9	28.4	244	93	5.3	1.6
29	0812	23.9	28.1	552	141	9.1	1.3 (3)
	Average..............................			319	73	4.6	0.99

(a) Measured within a few minutes of removal of filter from sampler and corrected back to collection time (uncorrected for thoron daughter interference).

(b) Filters are temporarily withdrawn from sampler at about 3 PM and counted. (Values are corrected back to removal time.) The filters are then replaced on sampler to complete the sampling period of about 24 hours. Thus, the values in this column are from the same filters that are counted at about 8 a.m. the following day.

(c) Thoron from alpha activity of filter sample counted 7 hours after taking a 24-96 hour sample.

(d) Gross beta activity when counted one day after end of sampling or later as indicated by numeral in parenthesis.

DATA ON RADIOACTIVITY IN AIR

U. S. Naval Research Laboratory

Radioactivity measurements of air-filter samples collected at various sites along the 80th Meridian (West) are made by the U. S. Naval Research Laboratory under a program partially financed by the Atomic Energy Commission.

The daily record of fission product beta activity during May 1960 is shown in Table VIII, while the readioactivity profile for the same month is shown in Figure 10. All radioactivity concentrations are given in disintegrations per minute per cubic meter of air at the collecting site (2.2 disintegrations per minute per cubic meter equals 1 micromicrocurie per cubic meter).

197

TABLE VIII.—DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION

May 1960

(Disintegrations/minute per cubic meter of air)

Day	Punta Arenas, Chile	Puerto Montt, Chile	Santiago, Chile	Antofagasta, Chile	Chacaltaya, Bolivia	Lima, Peru	Guayaquil, Ecuador
1	0.01	0.07	0.14	0.08	0.04	0.01	0.07
2	0.01	0.07	0.14	0.08	0.04	0.01	0.07
3	0.01	0.06	0.08	0.06	0.02	0.01	0.05
4	0.01	0.06	0.08	0.06	0.02	0.01	0.05
5	0.09	0.03	0.08	0.08	0.02	0.02	0.07
6	0.09	0.03	0.08	0.08	0.02	0.02	0.07
7	-	0.05	0.11	0.05	0.04	0.01	0.07
8	-	0.05	0.11	0.05	0.04	0.01	0.07
9	0.07	0.05	0.07	0.05	0.04	0.01	0.07
10	0.07	0.10	0.07	0.08	0.05	0.01	0.07
11	0.07	0.10	0.07	0.08	0.05	0.01	0.07
12	-	0.08	0.09	0.07	0.02	0.05	0.05
13	-	0.08	0.09	0.07	0.02	0.05	0.07
14	-	0.05	0.07	0.07	0.08	0.01	0.12
15	-	0.05	0.07	0.07	0.08	0.01	0.07
16	0.07	0.05	0.07	0.07	0.08	0.01	0.07
17	0.07	0.05	0.06	0.10	0.20	0.03	0.07
18	0.07	0.05	0.06	0.10	0.20	0.03	0.07
19	0.02	0.04	0.05	-	0.04	0.02	0.07
20	0.02	0.04	0.05	-	0.04	0.02	0.07
21	-	0.03	0.09	-	0.02	0.01	0.09
22	-	0.03	0.09	-	0.02	0.01	0.07
23	-	0.03	0.09	-	0.02	0.01	0.14
24	-	-	0.06	-	0.04	0.01	0.04
25	-	-	0.06	-	0.04	0.01	0.04
26	-	-	0.07	-	0.04	0.02	0.07
27	-	-	0.07	-	0.04	0.02	0.07
28	-	-	0.14	-	0.04	0.02	0.07
29	-	-	0.14	-	0.04	0.02	0.07
30	-	-	-	-	0.04	0.02	0.05
31	-	-	-	-	0.05	0.05	0.09
Mean value	0.05	0.05	0.08	0.07	0.05	0.02	0.07

198<

TABLE VIII.—DAILY RECORD OF FISSION PRODUCT β-ACTIVITY COLLECTED BY AIR FILTRATION—Con.

May 1960

(Disintegrations/minute per cubic meter of air)

Day	Miraflores, Panama Canal	Mauna Loa, Hawaii	Miami, Florida	Washington, D.C.	Moosonee, Ontario, Canada	Thule, Greenland	Bravo, Arctic Ice Floe*
1	0.08	0.01	0.60	0.58	0.41	0.31	-
2	0.08	0.01	0.60	0.58	0.22	0.31	-
3	0.06	0.40	0.35	0.59	0.22	0.31	-
4	0.06	0.40	0.35	0.59	0.74	0.31	-
5	0.11	0.40	0.21	0.58	0.39	0.26	-
6	0.11	0.40	0.21	0.58	0.22	0.26	-
7	0.06	0.48	0.43	0.32	0.22	0.26	-
8	0.06	0.48	0.43	0.32	0.25	0.27	-
9	0.06	0.48	0.43	0.32	0.46	0.27	-
10	0.08	0.10	1.00	0.31	0.35	0.32	-
11	0.08	0.10	1.00	0.31	0.32	0.32	-
12	0.06	0.05	1.01	0.06	0.53	0.32	-
13	0.06	0.05	1.01	0.06	0.12	0.18	-
14	0.06	0.11	0.79	0.33	0.12	0.18	-
15	0.06	0.11	0.79	0.33	0.12	0.17	-
16	0.06	0.11	0.79	0.33	0.12	0.17	-
17	0.06	0.17	0.87	1.54	0.55	0.24	-
18	0.06	0.17	0.87	1.54	0.55	0.24	-
19	0.10	0.51	0.90	-	0.12	0.14	-
20	0.10	0.51	0.90	-	0.12	0.14	-
21	0.03	0.21	0.28	0.37	0.21	0.14	-
22	0.03	0.21	0.28	0.37	0.21	0.15	-
23	0.03	0.21	0.28	0.37	0.21	0.15	-
24	0.06	0.13	0.55	0.54	0.10	0.12	-
25	0.06	0.13	0.55	0.54	0.10	0.12	-
26	0.02	0.19	0.24	0.64	0.38	0.11	-
27	0.02	0.19	0.24	0.64	0.38	0.11	-
28	0.03	0.20	0.13	0.33	0.36	0.22	-
29	0.03	0.20	0.13	0.33	0.36	0.22	-
30	0.03	0.20	0.13	0.33	0.36	0.22	-
31	0.04	0.36	0.14	0.50	0.25	0.28	-
Mean value	0.06	0.23	0.53	0.49	0.29	0.22	-

* Arctic Ice Floe Station "Bravo"—no samples received.

199<

AVERAGE MEASUREMENTS OF SURFACE AIR AT STATIONS ALONG 80th MERIDIAN

U. S. Naval Research Laboratory

May 1960

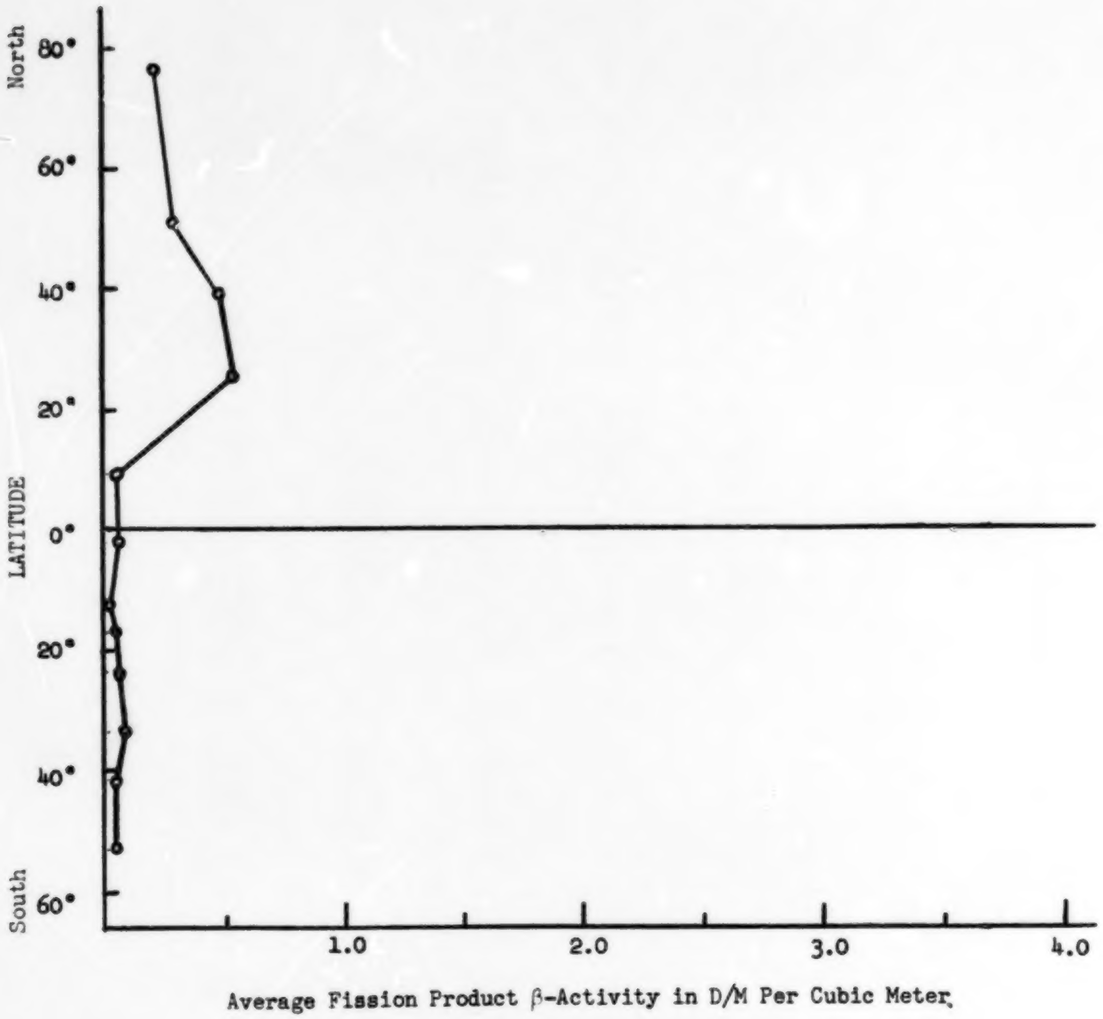


FIGURE 10

SECTION III.—WATER

PUBLIC HEALTH SERVICE NATIONAL WATER QUALITY NETWORK

The National Water Quality Network was established under the provisions of Section 4(c) of Public Law 660, which states that ". . .the Surgeon General shall . . . collect and disseminate basic data . . . (relating) to water pollution and the prevention and control thereof."

This Network, operated in cooperation with State and local health agencies, was started in October 1957. At present there are 75 sampling stations located on major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and for agricultural, industrial and other uses; some of these stations are interstate, coastal, and International Boundary waters, and waters on which activities of the Federal Government may have an impact. Ultimately a total of 250 to 300 stations will be operated. A few of the more recently established stations have not yet begun to report radioactivity.

Samples of water are examined for chemical, physical, and biological quality insofar as these relate to pollution. Samples for some determinations are taken weekly, others monthly, and for some continuous composite samples of 10 to 15 days are obtained. Radioactivity determinations are made on single samples, taken weekly.

Gross alpha and beta measurements are made on both suspended and dissolved solids in the raw surface water samples. The radioactivity levels of dissolved solids provide a rough measure of the levels which may be found in a treated water, where such water treatment removes substantially all of the suspended matter. Naturally occurring radioactive substances in the environment are the source of essentially all of the alpha activity. The contamination of the environment from man-made sources is the major contributor to the beta activity. It should be noted that with the cessation of weapons testing, beta activity in most raw waters is generally approaching a level attributed to only natural beta activity. Natural beta activity can be two or three times the natural alpha activity based on the same nuclides being present. Some exceptions to this are seen, notably the data for the Columbia River and the Animas River. The results are reported in micromicrocuries per liter, and are shown for each station on a given river.

While beta determinations for the first two years of the Network operation have been done on each sample weekly, the alpha determinations are reported generally on a composite sample of more than one week. Beginning with samples taken in January 1960, beta determinations are to be performed on composite samples obtained by combining two weekly samples. The alpha data will be reported on three-month composite samples, with 1/3 of the stations being covered each month. All the data reported below represent the average of all information available for the month indicated.

Strontium-90 data are reported as being the results of determinations on composite sample for a three-month period ending in the month shown.

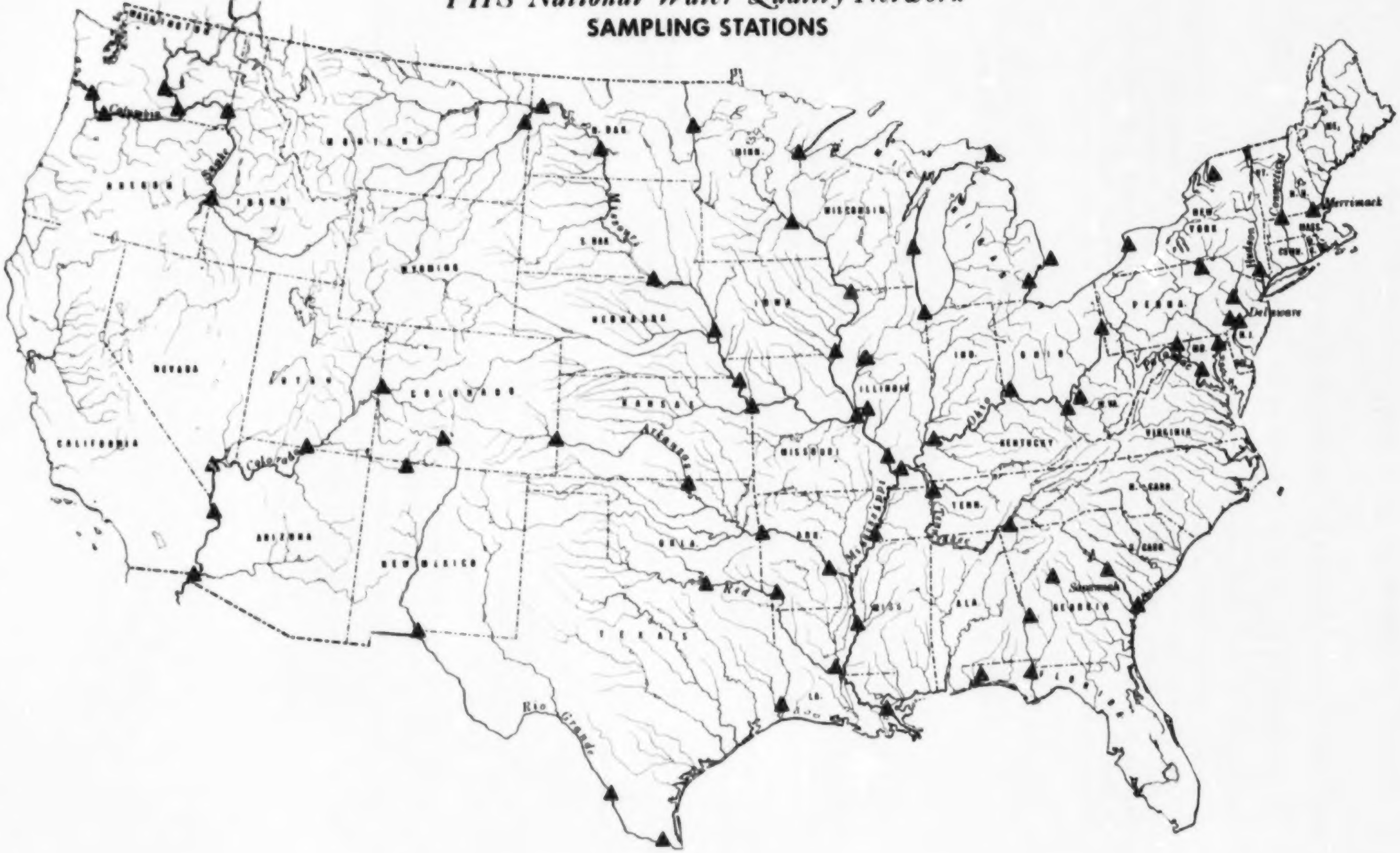
Additional information and data may be obtained from the following sources:

1. "National Water Quality Network Annual Compilation of Data," PHS Publication. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.50.

2. "Report on National Water Quality Control Network," submitted by Dr. F. J. Weber, Chief, Division of Radiological Health, PHS, to Joint Committee on Atomic Energy Hearings on Fallout from Nuclear Weapons Tests, Vol. 1, May 1959, Pages 167-169.

202<
203

PHS National Water Quality Network
SAMPLING STATIONS


Columbia
Snake
MONTANA
OREGON
IDAHO
NEVADA
CALIFORNIA
UTAH
WYOMING
COLORADO
Colorado
ARIZONA
NEW MEXICO
Rio Grande
N. DAK.
S. DAK.
Missouri
NEBRASKA
KANSAS
Arkansas
OKLA.
Red
TEXAS
MINN.
IOWA
WISCONSIN
MISSOURI
ARK.
LA.
Mississippi
ILLINOIS
IND.
OHIO
Ohio
KENTUCKY
TENN.
Tennessee
MISS.
ALA.
GEORGIA
Savannah
FLORIDA
S. CARO.
N. CARO.
VIRGINIA
W. VA.
PENNA.
NEW YORK
Hudson
Connecticut
Merrimack
VT.
N.H.
ME.
MASS.
CONN.
N.J.
Delaware

As of June 30, 1960

FIGURE 11

TABLE IX.--RADIOACTIVITY IN RAW SURFACE WATERS

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending 3/31/60	Month of March 1960					
	Strontium-90	Beta activity			Alpha activity		
		Susp.	Diss.	Total	Susp.	Diss.	Total
ALSEA RIVER							
Alsea, Oreg.	0.1	0	0	0	0	0	0
ANIMAS RIVER							
Cedar Hill, N. Mex.	0.5	374	6	380	150	6	156
ARKANSAS RIVER							
Coolidge, Kans.	1.2	0	0	0	0	56	56
Ponca City, Okla.	0.9	54	28	82	1	0	1
Pendleton Ferry, Ark.	0.8	0	0	0	3	2	5
CHATTAHOOCHIE RIVER							
Columbus, Ga.	0.5	<1	2	2	0	0	0
COLORADO RIVER							
Loma, Colo.	0.1	86	71	157	17	14	31
Page, Ariz.	0.2	4	6	10	14	12	26
Hoover Dam, Ariz.-Nev.	0.7	0	0	0	0	8	8
Parker Dam, Ariz.-Calif.	0.3	4	5	9	0	6	6
Yuma, Ariz.	0.3	3	0	3	0	6	6
COLUMBIA RIVER							
Wenatchee, Wash.	0.4	0	0	0	0	0	0
Pasco, Wash.	0.6	58	523	581	0	0	0
Bonneville Dam, Oreg.	0.3	35	246	281	<1	1	2
Clatskanie, Oreg.	0.1	18	107	125	<1	<1	1
CONNECTICUT RIVER							
Northfield, Mass.		5	1	6	-	-	-
DELAWARE RIVER							
Martin's Creek, Pa.	0.6	0	<1	<1	0	0	0
Philadelphia, Pa.	0.9	0	3	3	0	0	0
GREAT LAKES							
Gary, Ind.	0.5	0	0	0	-	-	-
Duluth, Minn.	0.2	0	1	1	0	0	0
Detroit, Mich.	0.3	0	3	3	0	0	0
Buffalo, N. Y.	0.9	0	1	1	0	1	1
HUDSON RIVER							
Poughkeepsie, N. Y.	1.7	0	0	0	0	1	1
ILLINOIS RIVER							
Peoria, Ill.	-	0	0	0	1	3	4
KANAWHA RIVER							
Winfield Dam, W. Va.	0.2	4	2	6	2	<1	2
MERRIMACK RIVER							
Lowell, Mass.	0.5	-	-	-	-	-	-
MISSISSIPPI RIVER							
Red Wing, Minn.	0.7	0	4	4	0	0	0
Dubuque, Iowa	1.4	0	0	0	0	0	0
Burlington, Iowa	1.0	0	0	0	0	1	1
East St. Louis, Ill.	0.5	0	0	0	0	0	0

TABLE IX.—RADIOACTIVITY IN RAW SURFACE WATERS—Con.

Public Health Service National Water Quality Network

(Micromicrocuries per liter)

Station	Quarter ending 3/31/60	Month of March 1960					
		Beta activity			Alpha activity		
	Strontium-90	Susp.	Diss.	Total	Susp.	Diss.	Total
MISSISSIPPI RIVER—Con.							
Cape Girardeau, Mo.	0.4	0	0	0	1	2	3
W. Memphis, Ark.	1.3	5	5	10	2	1	3
Delta, La.	1.0	9	7	16	2	1	3
New Orleans, La.	0.9	10	18	28	3	0	3
MISSOURI RIVER							
Bismarck, N. Dak.	0.5	6	13	19	0	4	4
Yankton, S. Dak.	1.7	3	4	7	0	2	2
Omaha, Nebr.	0.4	0	6	6	0	3	3
St. Joseph, Mo.	0.9	48	5	53	41	4	45
Kansas City, Kans.	0.5	22	<1	22	15	3	18
St. Louis, Mo.	0.9	10	5	15	0	1	1
OHIO RIVER							
East Liverpool, Ohio	0.5	0	2	2	0	1	1
Huntington, W. Va.	0.2	0	2	2	1	0	1
Cincinnati, Ohio	0.4	4	0	4	3	0	3
Evansville, Ind.	0.7	-	-	-	-	-	-
Cairo, Ill.	0.6	2	3	5	2	0	2
POTOMAC RIVER							
Williamsport, Md.	0.3	0	0	0	0	0	0
Great Falls, Md.	0.6	34	1	35	0	0	0
RED RIVER							
Denison, Tex.	1.4	0	1	1	0	0	0
Index, Ark.	0.7	<1	6	6	3	2	5
Alexandria, La.	1.3	0	3	3	-	-	-
RIO GRANDE RIVER							
Laredo, Tex.	0.1	3	1	4	0	5	5
Brownsville, Tex.	0.6	0	0	0	-	-	-
ST. MARY'S RIVER							
Sault Ste. Marie, Mich.	0.3	0	5	5	0	0	0
SCHUYLKILL RIVER							
Philadelphia, Pa.	0.5	0	0	0	0	0	0
SAVANNAH RIVER							
Port Wentworth, Ga.	0.2	2	4	6	0	0	0
SNAKE RIVER							
Wawawai, Wash.	0.3	0	<1	<1	1	0	1
Weiser, Idaho	-	0	0	0	1	1	2
SUSQUEHANNA RIVER							
Sayre, Pa.	-	0	0	0	0	0	0
TENNESSEE RIVER							
Chattanooga, Tenn.	0.4	4	70	74	0	0	0
YELLOWSTONE RIVER							
Sidney, Mont.	1.2	20	0	20	17	4	21

MONITORING OF WATER SUPPLIES AROUND THE NEVADA TEST SITE

By contract with the Atomic Energy Commission the Public Health Service has conducted an off-site monitoring program around the Nevada Test Site since 1955. Included in the program have been measurements of radioactivity in water supplies. These data have been reported in the Atomic Energy Commission's 13th, 14th, 18th and 23rd Semiannual Reports to Congress and by the Public Health Service in the 1957 Congressional Hearings, "The Nature of Radioactive Fallout and Its Effects on Man."

The following maps summarize the data on radioactivity (gross beta) in water supplies for the months of January-February 1960 and March-April 1960. The lower limit of detectability with the equipment used is about 10^{-8} microcuries per milliliter (10 micromicrocuries per liter).

TABLE X.—DESCRIPTION OF WATER SAMPLING POINTS

Nevada Test Site

Location	Source	Population served
Las Vegas	13 wells—650 to 1,250' depth plus Lake Mead supply.	40,000
Game Preserve	400' drilled well	20
Indian Springs	600' drilled well	Average 250
Pahrump	75' driven well	10-50
Ash Meadows	Spring 25' deep	8
Lathrop Wells	3 wells—600' deep	Average 15
Beatty	Spring	550
Lida Junction	125' drilled well	2-10
Goldfield	Spring	Average 200
Tonapah	2 drilled wells—60' depth	Average 1,500
Warm Springs	Multiple springs—no improvement	10
Diablo	Well	State Highway Station
Lincoln Mine	2 driven wells	3
Caliente	Springs	Average 10-12
Crystal Springs	Free flowing spring	0
Alamo	2 wells—50-67' deep	Average 175
Pahranagat Lake	Surface	Not used for domestic purposes
Butler Ranch	Flowing spring	1
Warm Spring Ranch	Flowing spring from earth fault	Public park with swimming pool
Logandale	Drilled well	300
Ballistic Range	Drilled well	10-15

GROSS BETA MEASUREMENTS IN WATER SUPPLIES IN OFF-SITE AREAS OF THE NEVADA TEST SITE FOR JANUARY-FEBRUARY 1960
($\mu c/ml$ at count time)

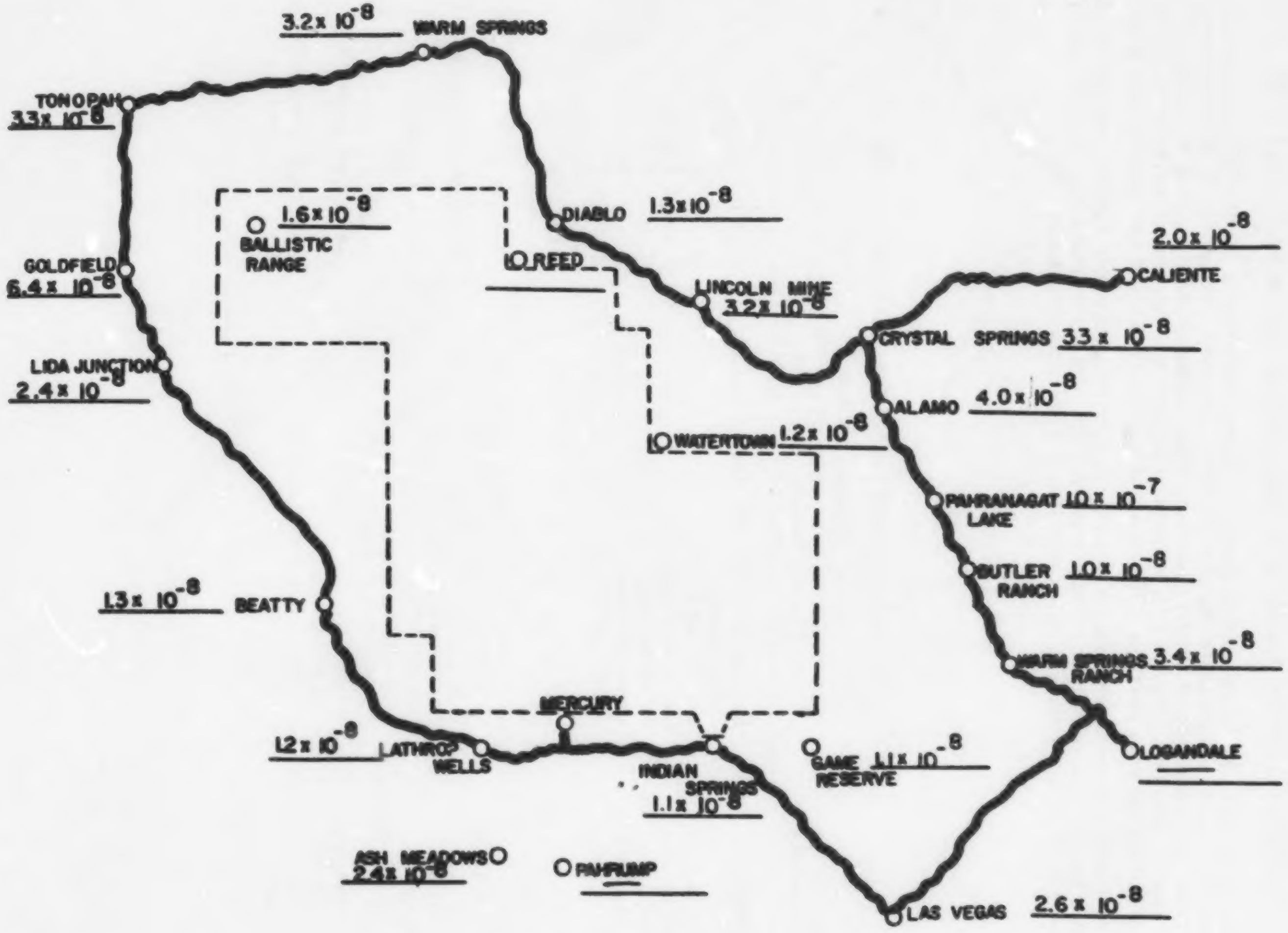
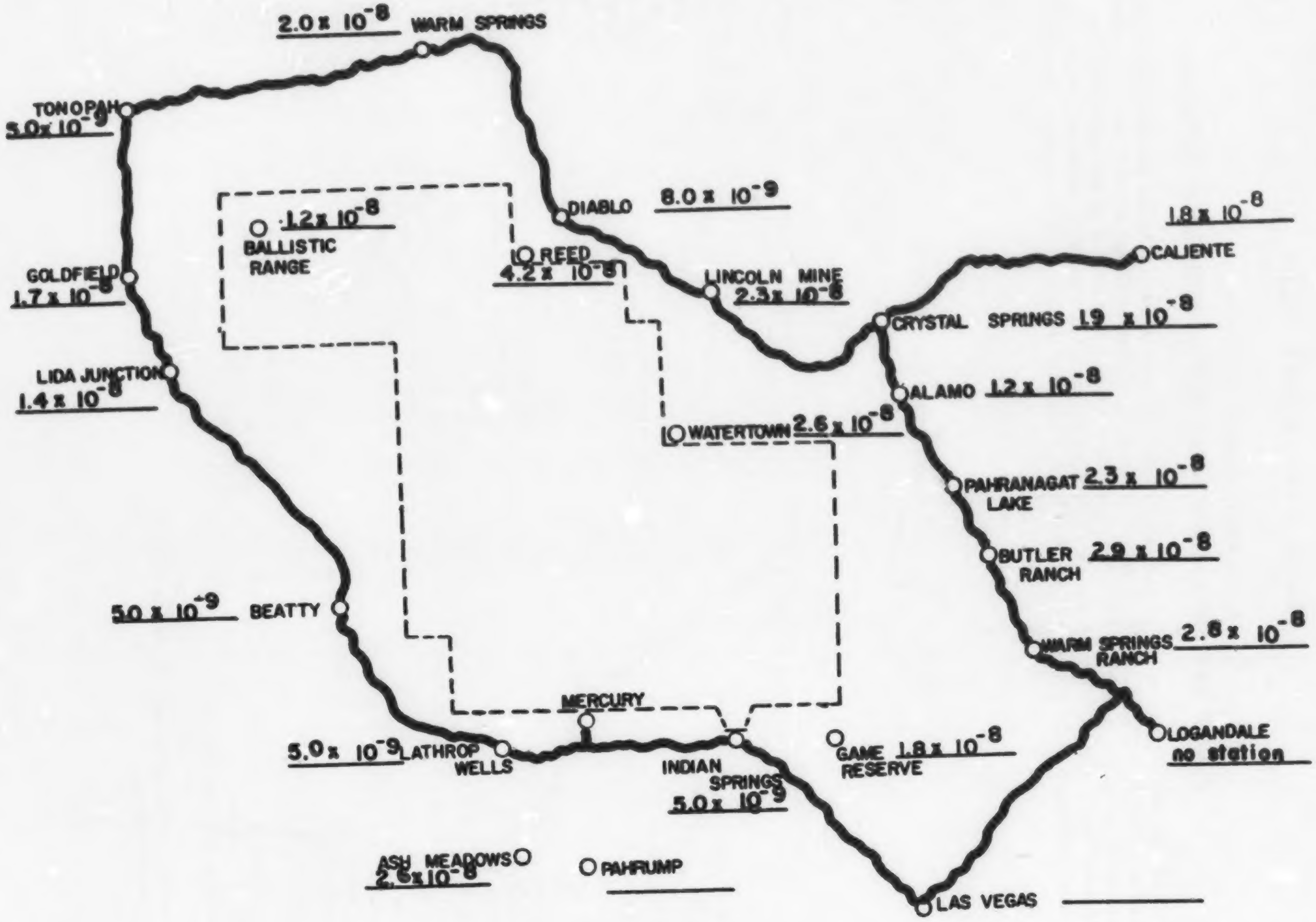

3.2 x 10^-8 WARM SPRINGS
TONOPAH 3.3 x 10^-8
GOLDFIELD 6.4 x 10^-8
LIDA JUNCTION 2.4 x 10^-8
1.3 x 10^-8 BEATTY
1.2 x 10^-8 LATHROP WELLS
ASH MEADOWS 2.4 x 10^-8
PAHRUMP
MERCURY
INDIAN SPRINGS 1.1 x 10^-8
GAME RESERVE 1.1 x 10^-8
LAS VEGAS 2.6 x 10^-8
LOGANDALE
WARM SPRINGS RANCH 3.4 x 10^-8
BUTLER RANCH 1.0 x 10^-8
PAHRANAGAT LAKE 1.0 x 10^-7
ALAMO 4.0 x 10^-8
CRYSTAL SPRINGS 3.3 x 10^-8
CALIENTE 2.0 x 10^-8
LINCOLN MINE 3.2 x 10^-8
WATERTOWN 1.2 x 10^-8
DIABLO 1.3 x 10^-8
REED
BALLISTIC RANGE 1.6 x 10^-8

FIGURE 12

206<

GROSS BETA MEASUREMENTS IN WATER SUPPLIES IN OFF-SITE AREAS OF THE NEVADA TEST SITE FOR MARCH-APRIL 1960
($\mu c/ml$ at count time)



2.0 x 10^-8 WARM SPRINGS
TONOPAH 5.0 x 10^-9
GOLDFIELD 1.7 x 10^-8
LIDA JUNCTION 1.4 x 10^-8
.1.2 x 10^-8 BALLISTIC RANGE
DIABLO 8.0 x 10^-9
REED 4.2 x 10^-8
LINCOLN MINE 2.3 x 10^-8
1.8 x 10^-8 CALIENTE
CRYSTAL SPRINGS 1.9 x 10^-8
ALAMO 1.2 x 10^-8
WATERTOWN 2.6 x 10^-8
PAHRANAGAT LAKE 2.3 x 10^-8
BUTLER RANCH 2.9 x 10^-8
5.0 x 10^-9 BEATTY
WARM SPRINGS RANCH 2.8 x 10^-8
MERCURY
5.0 x 10^-9 LATHROP WELLS
INDIAN SPRINGS 5.0 x 10^-9
GAME RESERVE 1.8 x 10^-8
LOGANDALE no station
ASH MEADOWS 2.6 x 10^-8
PAHRUMP
LAS VEGAS

FIGURE 13

2078

SECTION IV.—OTHER DATA

EXTERNAL GAMMA ACTIVITY
PUBLIC HEALTH SERVICE RADIATION SURVEILLANCE NETWORK

Portable survey instruments are available at the stations of the Radiation Surveillance Network and one of their uses is to record external gamma radiation. These readings are not precise, especially for measurement of low levels but they can show the presence or absence of any significant increases above background. The differences among the values shown on the following table are within the variances anticipated due to differences in normal background and in instrument response characteristics.

TABLE XI.—EXTERNAL GAMMA ACTIVITY

Public Health Service Radiation Surveillance Network

April 1960

Station location	Average*	Station location	Average*
	mr/hr		mr/hr
Alaska, Anchorage	0.01	Mississippi, Pascagoula	(**)
Alaska, Fairbanks	0.01	Missouri, Jefferson City	0.01
Alaska, Juneau	0.02	Montana, Helena	0.03
Arizona, Phoenix	0.02	New Jersey, Trenton	0.02
Arkansas, Little Rock	0.02	New Mexico, Santa Fe	0.04
California, Berkeley	0.01	New York, Albany	0.02
California, Los Angeles	0.01	North Carolina, Gastonia	0.02
Colorado, Denver	0.02	Ohio, Cincinnati	(**)
Connecticut, Hartford	0.01	Oklahoma, Oklahoma City	0.02
District of Columbia	0.02	Oklahoma, Ponca City	0.04
Florida, Jacksonville	0.02	Oregon, Portland	0.02
Georgia, Atlanta	0.02	Pennsylvania, Harrisburg	0.01
Hawaii, Honolulu	0.02	Rhode Island, Providence	0.02
Idaho, Boise	0.01	South Carolina, Columbia	0.02
Illinois, Springfield	0.01	South Dakota, Edgemont	0.02
Indiana, Indianapolis	0.01	South Dakota, Pierre	0.02
Iowa, Iowa City	0.02	Texas, Austin	0.01
Kansas, Topeka	0.02	Texas, El Paso	0.02
Louisiana, New Orleans	0.02	Utah, Salt Lake City	0.02
Maryland, Baltimore	0.02	Virginia, Richmond	0.01
Massachusetts, Lawrence	0.02	Washington, Seattle	0.02
Michigan, Lansing	0.02	Wyoming, Cheyenne	0.02
Minnesota, Minneapolis	0.01		

*Readings taken three feet above the ground.
**No data received.

208<

FOOD CONSUMPTION OF HOUSEHOLDS IN THE UNITED STATES

Northeast and North Central Regions

As a necessary step in the evaluation of the radiological aspects of radioactivity in foods, there must be estimates of the kinds and amounts of food used. The Department of Agriculture is preparing a series of such estimates, the first of which were for the United States as a whole and appeared in the August issue of *Radiological Health Data*. Two additional reports, "Food Consumption Per Person in Households in the Northeast Region of the United States," and "Food Consumption Per Person in Households in the North Central Region of the United States" have been completed and are reproduced herewith.

Two remaining reports, covering the Western and Southern Regions of the United States, will be printed in the October issue.

210<

FOOD CONSUMPTION SURVEY REGIONS

U.S. Department of Agriculture

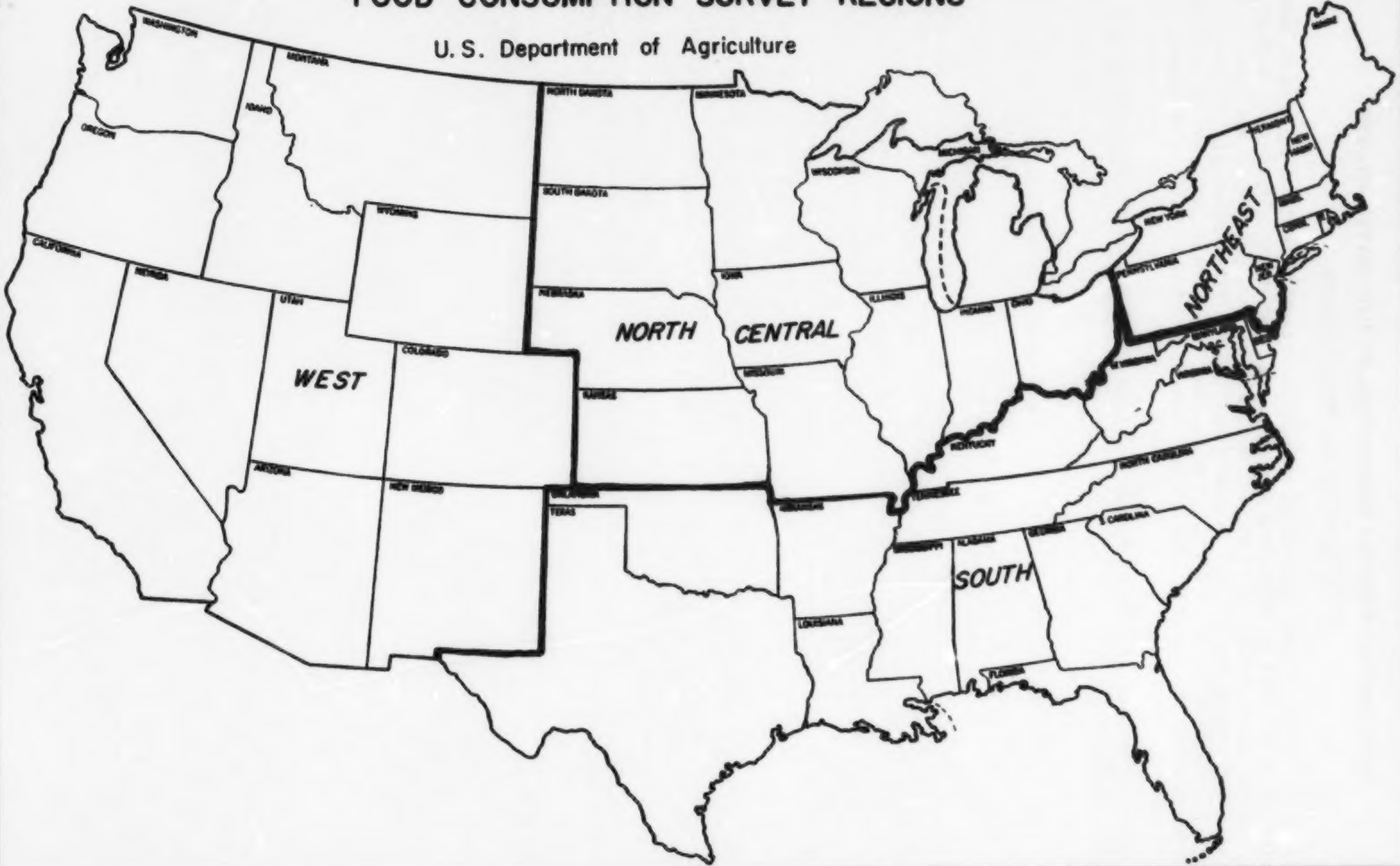

WEST
NORTH CENTRAL
NORTHEAST
SOUTH
WASHINGTON
OREGON
CALIFORNIA
IDAHO
MONTANA
NEVADA
UTAH
WYOMING
COLORADO
ARIZONA
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
MINNESOTA
IOWA
MISSOURI
WISCONSIN
MICHIGAN
ILLINOIS
INDIANA
OHIO
OKLAHOMA
TEXAS
ARKANSAS
LOUISIANA
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
VIRGINIA
W. VIRGINIA
PENNSYLVANIA
NEW YORK
MAINE

FIGURE 14

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Household Economics Research Division
Washington 25, D. C.

Tables XII and XIII showing average "per person quantities" of foods used per week (in pounds) and per day (in grams), have been derived from data in "Household Food Consumption Survey," 1955, Reports No. 2 and No. 3, available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $1.00 per copy.

Averages are for foods used at home during a week in the spring, as brought into the household, and are based on all housekeeping households in the respective sections of the country. "Per person quantities" were computed by dividing "household quantities" by the "average household size" (3.20 in the Northeast, and 3.31 in the North Central region). "Average household size" was derived by dividing by 21 the total number of meals served from family food supplies during the survey week.

For some purposes, information on the consumption of those actually using a given food is more useful than averages based on all persons. An approximate but not precise figure can be computed from these data. Information was obtained in the survey on household use only—not on the individual member use of foods. Estimated quantities of food per person may be obtained by dividing the "quantities used per person per week" based on all households by the "percentage of households using" shown in the second column. For example, the estimate of the average per-person use of commercially baked white bread per week (in Northeastern households using) is 1.41 pounds, derived by dividing 1.23 from the third column by 0.872 from the second column, page 39. Such an estimate understates the value for those actually using the food, since it is not reasonable to assume that all members of all households reporting such use of the food actually used some of the item. The understatement is probably small for such items as bread, sugar, etc., that in many households are likely to be eaten by every member, but it may be considerable for items such as tea, coffee, or baby foods that are less likely to be used by all members.

The estimate of the "quantity per person using" an item computed from this table will also be understated when the average size of household utilizing food is smaller than the average of all households. The average size of households using lamb and mutton for instance, is approximately 3.07 instead of 3.33 persons (all U. S.) and the average "per person per week" in households using is 0.84 pounds rather than the 0.77 pounds computed from the figures in this table (see August 1960 issue).

On the other hand, the estimated average computed from this table will be overstated when the average size of the households using is larger than that of all households. This is true, for example, for such items as ice cream (3.55 persons) and breakfast cereals (3.48 persons).

While estimates computed from these data will provide an indication of the importance of an item in the individual diet, they do not show the maximum likely to be used, such as would be shown by the percentage distribution using specified amounts per person. Also, since the averages for those using the items are not additive, combinations of items cannot be easily estimated.

TABLE XII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTHEAST REGION OF THE UNITED STATES, 1955

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)
	Percent	Pounds	Grams
Milk, cream, ice cream, cheese (fluid milk equivalent[1])	99.9	9.72	630
Fresh fluid milk, total	97.3	7.37	478
Whole	96.1	7.00	453
Buttermilk	7.1	.09	6
Skim	7.5	.20	13
Chocolate (commercial)	5.6	.08	5
Half and half, extra rich	.2	(*)	(*)
Processed milk:			
Evaporated	28.9	.22	14
Condensed	1.4	.01	(*)
Dry, total	9.8	.02	1
Nonfat	5.5	.02	1
Whole	2.2	.01	(*)
Products, nonfat and whole[2]	2.7	(*)	(*)
Cream, total[3]	30.3	.10	6
Light	10.5	.04	2
Heavy, whipped, whip topping	21.0	.06	4
Ice Cream, ice milk (commercial)[4]	60.8	.34	22
Cheese, total	85.6	.33	22
Cottage	33.5	.11	7
Nonprocessed, total[5]	40.4	.08	5
American-type	12.9	.03	2
Swiss	7.4	.01	1
Cream	18.2	.02	1
Other	10.7	.02	1
Processed, total[6]	58.3	.14	9
American, Swiss, cream, other	53.0	.12	8
Cheese spreads	9.5	.02	1
Fats and oils, total	99.6	.76	49
Table fats, total	98.4	.43	28
Butter	72.7	.24	16
Margarine	50.4	.19	12
Shortening, total	53.3	.13	9
Lard[7]	12.7	.04	3
Other	43.7	.09	6
Salad and cooking oils	29.5	.08	5
Salad dressings (commercial), total	62.4	.12	8
Mayonnaise and mayonnaise-type	40.3	.06	4
French and french-type	10.8	.01	1
Other[8]	18.5	.05	3

* Less than 0.005 pounds or 0.5 grams.

[1] Approximately the quantity of fluid milk to which the various dairy products (except butter) are equivalent in calcium.

[2] Chiefly dry cocoa mixes.

[3] Includes small amounts of powdered cream, not shown separately.

[4] Includes frozen custard and frozen desserts with vegetable fats.

[5] Includes quantities of cheese for which respondent could not report whether or not processed.

[6] Includes small amounts of cheese food, not shown separately.

[7] Includes small amounts of chicken fat.

[8] Includes sandwich spreads.

TABLE XII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTHEAST REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
	Percent	Pounds	Grams
Flour and other cereal products, total	95.9	1.03	67
Flour other than mixes, total	59.4	.32	21
White	59.0	.32	21
Other	1.4	.01	(*)
Prepared flour mixes, total	36.6	.17	11
Pancake	12.3	.03	2
Cake	16.6	.08	5
Biscuit, roll, muffin	10.5	.03	2
Other	9.2	.03	2
Breakfast cereals (excluding baby cereals), total	77.4	.25	16
Ready-to-eat, total	69.1	.19	12
Corn flakes	39.1	.07	4
Wheat, flaked, puffed, shredded	37.5	.07	5
Rice, flaked, puffed, etc.	20.9	.02	2
Other	14.2	.02	2
Hot, total[9]	24.7	.06	4
Rolled oats, oatmeal	18.9	.04	3
Wheat cereals	8.6	.02	1
Other cereals, total	68.0	.29	19
Baby cereals	7.4	.01	1
Rice	23.4	.06	4
Cornmeal, grits, total	4.2	.01	1
Cornmeal	2.9	.01	(*)
Hominy grits	1.7	.01	(*)
Hominy (big)	.2	(*)	
Macaroni, spaghetti, noodles	51.5	.19	12
Popcorn	4.7	.01	1
Other[10]	11.0	.01	1
Bakery products, total	99.0	2.22	144
Bread, total	97.2	1.53	99
White[11]	87.2	1.23	80
Whole wheat	17.2	.10	6
Other	39.8	.20	13
Baked goods other than bread, total	86.6	.69	45
Crackers, total	55.9	.15	10
Sweet	12.2	.03	2
Not sweet	50.5	.13	8
Rolls, total	22.6	.07	4
Ready-to-eat	18.3	.05	3
Brown and serve	5.0	.01	1
Biscuits, muffins	6.0	.01	1
Cakes	28.0	.14	9
Pies	17.4	.10	6
Other[12]	53.9	.22	14

[9] Includes small amounts of other hot cereals not shown separately.
[10] Includes tapioca, cornstarch, barley, buckwheat grits.
[11] Practically all reported as enriched.
[12] Includes cookies, doughnuts, sweet buns, coffee cake, etc.

213<

TABLE XII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTHEAST REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
	Percent	Pounds	Grams
Eggs	98.9	0.78	51
Meat, poultry, fish, total	99.6	4.33	281
Meat, total	99.1	3.07	199
Beef, total	93.3	1.29	83
Steak, fresh, frozen, total	53.9	.39	26
Round	23.9	.16	10
Other	35.3	.24	15
Roast, fresh, frozen, total	30.2	.36	23
Rib	7.1	.09	6
Other	23.7	.27	17
Stewing, boiling, fresh, frozen	18.4	.11	7
Corned, chipped, dried	8.6	.03	2
Ground, fresh, frozen	66.1	.39	25
Canned (commercial)	1.6	(*)	(*)
Veal, total[13]	20.5	.12	8
Roast, shoulder, fresh, frozen	4.5	.04	3
Chops, cutlets, fresh, frozen	15.4	.08	5
Pork, total	84.5	.98	63
Fresh, frozen, total	50.9	.47	31
Chops	31.5	.17	11
Ham	7.4	.07	5
Loin	8.1	.09	6
Sausage	12.3	.05	3
Other	8.8	.08	5
Cured, smoked, total	73.0	.48	31
Ham, raw, precooked	30.9	.24	16
Bacon	58.6	.17	11
Salt pork	4.8	.01	1
Other	9.5	.06	4
Canned (commercial)	1.8	.02	1
Lamb, mutton, total	23.0	.19	12
Chops, steak, fresh, frozen	14.8	.08	5
Roast, shoulder, leg, fresh, frozen	7.0	.09	6
Stewing, soup, ground, patties	2.1	.02	1
Variety meats and game, total	27.8	.13	8
Liver	23.5	.09	6
Other[14]	6.0	.04	3
Luncheon meats, total	70.1	.37	24
Frankfurters	40.0	.16	10
Other, total	58.1	.21	14
Canned	3.7	.01	1
Other	56.4	.20	13
Poultry, total[15]	54.9	.83	54
Chicken[16]	51.1	.69	45
Turkey[16]	4.3	.12	7

[13] Includes small amounts of other veal, not shown separately.

[14] Includes tongue, kidney, heart, tripe, etc.; game.

[15] Includes small amounts of other poultry, not shown separately.

[16] Chiefly fresh or frozen, only small amounts of canned reported.

TABLE XII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTHEAST REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
	Percent	Pounds	Grams
Meat, poultry, fish—Con.			
Fish and shellfish, total	74.4	0.44	29
Fish, total[17]	68.4	.34	22
Canned (commercial), total	39.8	.09	6
[illegible]	11.4	.03	2
[illegible]	28.1	.05	3
[illegible][18]	6.2	.01	1
Fresh, frozen	40.1	.24	16
Shellfish, fresh, frozen, canned	17.6	.10	6
Sugar, sweets, total	95.6	.99	64
Sugar, total	91.7	.67	43
White, total	91.5	.65	42
Granulated	91.4	.60	39
Confectioners, powdered	14.7	.05	3
Brown	9.5	.02	1
Sirups, molasses, honey, total	26.8	.07	4
Sirups, total	18.4	.05	3
Corn, cane	6.5	.02	1
Maple, sorghum, other[19]	12.5	.03	2
Molasses	5.9	.01	1
Honey	4.9	.01	1
Jellies, jams, total	57.1	.13	9
Jellies	31.0	.06	4
Jams, preserves, fruit butters, etc.	32.3	.07	4
Candies (commercial), total	42.2	.12	8
With nuts	15.0	.03	2
Without nuts	32.3	.09	6
Potatoes, sweetpotatoes, total	94.2	1.96	127
Fresh, total	92.4	1.90	123
White	91.7	1.85	120
Sweetpotatoes	7.5	.05	3
Frozen[20]	8.7	.02	2
Canned, dehydrated[21]	1.4	(*)	(*)
Potato chips and sticks[22]	19.0	.03	2
Fresh vegetables, total[23]	98.7	2.64	171
Dark green and deep yellow, total[24]	75.4	.51	33
Dark green leafy, total	30.8	.15	10
Spinach	15.9	.06	4
Other	18.9	.09	6
Broccoli	9.0	.06	4
Carrots	59.7	.24	16
Peppers, green	22.9	.05	3

[17] Includes small amounts of smoked, cured fish, not shown separately.

[18] May include small amount of ready-cooked fish, not canned.

[19] See page 44 for chocolate sirup.

[20] Chiefly french fried.

[21] Chiefly canned sweetpotatoes.

[22] Chiefly chips.

[23] Includes home canned and frozen vegetables that were brought into the home in fresh form.

[24] Includes other dark green and deep yellow vegetables not shown separately.

215<

TABLE XII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTHEAST REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food	Households using	Quantity per person	
		In a week	Per day
(1)	(2)	(3)	(4)
	Percent	Pounds	Grams
Fresh vegetables, Con.			
Other green, total	88.8	0.94	61
Asparagus	25.2	.16	10
Beans, snap, wax	26.9	.12	8
Cabbage	31.7	.25	16
Lettuce	74.6	.34	22
Peas	7.8	.04	2
Other	6.3	.03	2
Tomatoes	67.6	.34	22
Other than tomatoes and green and deep yellow, total	91.7	.85	55
Celery	44.5	.13	9
Cucumbers	28.0	.10	7
Mature onions	73.8	.29	19
Green onions	14.6	.03	2
Other, total[25]	45.9	.30	19
Corn	16.2	.12	8
Fresh fruits, total[26]	92.8	2.93	190
Citrus, total[27]	68.4	1.24	80
Grapefruit	29.5	.38	25
Lemons, limes[28]	24.6	.06	4
Oranges	50.7	.79	51
Other than citrus, total[29]	86.0	1.69	110
Apples	46.8	.41	27
Bananas	56.3	.44	29
Melons	19.9	.33	22
Rhubarb	11.9	.08	5
Strawberries	21.8	.17	11
Avocados	2.6	.01	1
Berries other than strawberries	3.7	.02	1
Cherries	8.1	.04	3
Peaches	9.3	.08	5
Other	14.5	.10	7
Commercially frozen fruits and vegetables	44.1	.22	14
Fruits[30]	11.7	.03	2
Vegetables other than potatoes, total	38.4	.19	12
Beans, lima	9.5	.02	2
Beans, snap, wax	9.8	.02	2
Broccoli	10.6	.02	2
Peas	14.4	.04	3
Spinach	7.3	.02	1
Corn	3.3	.01	1
Other	14.3	.04	3

---

[25] Includes beets, cauliflower, turnips, rutabagas, and others not shown separately.

[26] Includes home canned and frozen fruits that were brought into the home in fresh form.

[27] Includes small amounts of tangerines and kumquats not shown separately.

[28] Chiefly lemons.

[29] Includes small amounts of figs and grapes not included in "Other."

[30] Chiefly strawberries.

216

TABLE XII.–FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTHEAST REGION OF THE UNITED STATES, 1955–Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
	Percent	Pounds	Grams
Commercially canned fruits and vegetables, total ..	86.1	1.23	80
Fruits, except baby and junior foods, total	53.8	.42	27
Apples, applesauce	20.0	.09	6
Apricots	3.7	.02	1
Berries	4.4	.02	1
Cherries	4.8	.01	1
Peaches	18.3	.09	6
Pears	10.2	.05	3
Pineapple	11.9	.05	3
Plums, prunes	2.4	.01	1
Mixed fruit, fruit cocktail	10.9	.05	3
Other	6.8	.03	2
Baby, junior foods, including juices	8.9	.05	3
Vegetables, except baby and junior foods, total[31]	74.4	.73	47
Asparagus	3.7	.01	1
Baked beans, or other mature beans	16.7	.09	6
Beans, lima, green, immature	3.8	.01	1
Beans, snap, wax	21.8	.10	6
Beets	15.6	.05	3
Corn	24.8	.11	7
Peas, green, immature	31.5	.14	9
Tomatoes, total	27.7	.15	10
Pulp	14.0	.08	5
Puree, paste	19.3	.07	4
Other	20.2	.08	5
Baby, junior foods, incl. potatoes	5.8	.03	2
Fruit and vegetable juices, fresh, frozen, canned, powdered[32, 33]	73.2	1.31	85
Canned citrus, total[32, 34]	21.7	.28	18
Orange	11.1	.18	11
Grapefruit	8.6	.08	5
Canned fruit other than citrus[32]	29.5	.27	17
Canned tomato and other vegetable juices[32, 35]	26.7	.20	13
Frozen, concentrated, total	31.5	.14	9
Orange	28.3	.12	8
Other	6.7	.02	1
Fresh (commercial)	4.6	.05	3
Dried fruits and vegetables, total[36]	31.3	.11	7
Dried fruit, total	18.3	.05	3
Prunes	8.2	.03	2
Raisins, currants	9.2	.02	1
Other	4.3	.01	1

[31] Includes small amounts of mature peas not included in "Other."
[32] Single strength equivalent.
[33] Does not include baby or junior juices. See above.
[34] Includes orange and grapefruit blend and other citrus juices not shown separately.
[35] Includes both commercially and home-canned and frozen juices.
[36] Includes both commercially and home-dried fruits and vegetables.

217<

TABLE XII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTHEAST REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	 Per day (4)
	Percent	Pounds	Grams
Dried fruits and vegetables—Con.			
Dry vegetables, total	16.0	0.05	3
Beans, total	11.7	.04	3
Lima	3.7	.01	1
Navy, pinto, kidney, other	8.3	.03	2
Peas, lentils, other	5.2	.01	1
Beverages:			
Coffee, total[37]	91.9	.23	15
Bean, ground	68.0	.22	14
Instant, powdered	31.3	.02	1
Substitute	3.2	(*)	(*)
Tea[38]	29.0	.03	2
Chocolate, cocoa, chocolate sirup, total	21.3	.03	2
Chocolate	5.6	.01	(*)
Cocoa	12.3	.01	1
Chocolate sirup	4.9	.01	1
Soft drinks, fruit ades, total	58.3	.93	61
Soft drinks, bottled and canned, total	53.7	.90	58
Cola-type	26.2	.39	25
Fruit flavored	14.8	.20	13
Other	24.1	.31	20
Powdered	4.1	(*)	(*)
Fruit ades, total	8.1	.03	2
Frozen	6.2	.02	1
Other	2.0	.01	1
Miscellaneous foods:			
Nuts (shelled weight) and peanut butter, total	46.3	.09	6
Nuts (shelled weight), total	20.0	.03	2
Peanuts	8.4	.02	1
Other	13.5	.02	1
Peanut butter	33.9	.06	4
Soups, except canned baby soups, total	49.2	.24	16
Vegetable, total	35.3	.14	9
Condensed	30.3	.13	9
Other	4.7	.01	1
Meat, fish, grain, total	25.5	.10	6
Condensed	21.7	.09	6
Other	5.2	.01	1
Catsup, chili sauce, etc., total[39]	48.3	.12	8
Catsup	38.0	.06	4
Chili sauce	3.2	.01	(*)
Barbecue sauce, etc.	13.2	.04	3
Tomato relishes	3.8	.01	1
Pickles, olives, relishes, total[39]	38.8	.12	7
Pickles	27.2	.08	5
Olives	14.7	.02	1
Relishes other than tomato	6.3	.01	1

[37] Includes small amounts of liquid concentrate coffee, not shown separately.
[38] Data refers to amounts bought during the 7-day survey period rather than the amounts used.
[39] Includes both commercial and homemade products.

TABLE XII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTHEAST REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Agriculture

Food (1)	Households using (2)	Quantity per person In a week (3)	 Per day (4)
	Percent	Pounds	Grams
Miscellaneous foods—Con.			
Puddings, pie fillings, miscellaneous sweets (commercial), total[40]	43.4	0.09	6
Puddings, pie fillings[41]	37.4	.06	4
Strained canned puddings (baby)	3.3	.01	1
Sherbets, ices	5.1	.02	1
Icing mix, fudge mix	2.4	(*)	(*)
Other mixtures, prepared or partially prepared, total	37.0	.22	14
Mixtures other than baby, junior foods, total	32.7	.18	12
Without meat[42]	15.1	.06	4
With meat[43]	23.0	.12	8
Baby, junior foods, total	7.1	.04	3
Meat, mixtures with meat	6.7	.03	2
Without meat	2.4	.01	(*)
Leavening agents, total[44]	10.5	.02	1
Yeast	6.3	(*)	(*)
Other[44]	5.2	.01	1
Seasonings[44]			
Vinegar	9.8	.05	3
Salt	17.3	.09	6

[40] Includes other miscellaneous sweets not shown separately.

[41] Chiefly dry, including plain gelatin.

[42] Includes spaghetti with tomato sauce, potato salad, cole slaw, macaroni and cheese dinners, chow mein and chop suey dinners, and others.

[43] Includes poultry and meat pies, spaghetti with meat balls, corned beef hash, chili con carne, ravioli, tamales, and others.

[44] Data refer to amount bought during the 7-day survey period rather than the amounts used.

219<

TABLE XIII.–FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTH CENTRAL REGION OF THE UNITED STATES, 1955

U. S. Department of Commerce

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
	Percent	Pounds	Grams
Milk, cream, ice cream, cheese (fluid milk equivalent[1])	99.9	10.24	663
Fresh fluid milk, total	97.2	8.05	522
Whole	95.2	7.52	487
Buttermilk	11.3	.14	9
Skim	6.2	.24	16
Chocolate (commercial)	6.0	.07	5
Half and half, extra rich	14.2	.08	5
Processed milk:			
Evaporated	22.2	.16	10
Condensed	2.1	.01	1
Dry, total	10.8	.02	2
Nonfat	5.0	.01	1
Whole	1.8	.01	(*)
Products, nonfat and whole[2]	4.3	.01	1
Cream, total[3]	28.8	.12	8
Light	9.2	.04	3
Heavy, whipped, whip topping	20.4	.08	5
Ice cream, ice milk (commercial)[4]	64.5	.47	30
Cheese, total	82.2	.38	25
Cottage	48.2	.20	13
Nonprocessed, total[5]	31.5	.07	5
American-type	15.5	.04	3
Swiss	3.4	.01	(*)
Cream	10.1	.02	1
Other	6.2	.01	1
Processed, total[6]	48.9	.11	7
American, Swiss, cream, other	41.5	.10	6
Cheese spreads	9.6	.02	1
Fats and oils, total	99.5	88	57
Table fats, total	98.4	.44	29
Butter	67.1	.25	16
Margarine	55.1	.19	12
Shortening, total	74.5	.24	15
Lard[7]	26.5	.10	6
Other	53.6	.14	9
Salad and cooking oils	19.8	.04	3
Salad dressings (commercial), total	69.1	.16	10
Mayonnaise and mayonnaise-type	32.1	.05	3
French and french-type	25.1	.02	2
Other[8]	29.9	.08	5

* Less than 0.005 pounds or 0.5 grams.

[1] Approximately the quantity of fluid milk to which the various dairy products (except butter) are equivalent in calcium.

[2] Chiefly dry cocoa mixes.

[3] Includes small amounts of powdered cream, not shown separately.

[4] Includes frozen custard and frozen desserts with vegetable fats.

[5] Includes quantities of cheese for which respondent could not report whether or not processed.

[6] Includes small amounts of cheese food, not shown separately.

[7] Includes small amounts of chicken fat.

[8] Includes sandwich spreads.

220<

TABLE XIII.--FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTH CENTRAL REGION OF THE UNITED STATES, 1955--Con.

U. S. Department of Commerce

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)
	Percent	Pounds	Grams
Flour and other cereal products, total	97.4	1.40	91
Flour other than mixes, total	84.6	.62	40
White	84.6	.61	40
Other	1.9	.01	1
Prepared flour mixes, total	46.6	.22	14
Pancake	15.6	.04	3
Cake	26.4	.12	8
Biscuit, roll, muffin	13.7	.04	3
Other	8.0	.02	2
Breakfast cereals (excluding baby cereals), total	83.0	.28	18
Ready-to-eat, total	73.9	.21	13
Corn flakes	39.9	.08	5
Wheat, flaked, puffed, shredded	41.2	.08	5
Rice, flaked, puffed, etc	17.6	.02	1
Other	17.4	.03	2
Hot, total[9]	34.3	.08	5
Rolled oats, oatmeal	28.3	.06	4
Wheat cereals	11.1	.02	1
Other cereals, total	67.8	.27	18
Baby cereals	9.1	.01	1
Rice	20.7	.04	3
Cornmeal, grits, total	11.3	.05	3
Cornmeal	10.8	.05	3
Hominy grits	1.4	(*)	(*)
Hominy (big)	1.9	.01	1
Macaroni, spaghetti, noodles	42.0	.12	8
Popcorn	13.8	.03	2
Other[10]	16.5	.01	1
Bakery products, total	98.4	2.25	146
Bread, total	95.7	1.62	105
White[11]	88.3	1.36	88
Whole wheat	19.5	.11	7
Other	31.1	.15	10
Baked goods other than bread, total	85.1	.63	41
Crackers, total	57.9	.14	9
Sweet	14.8	.03	2
Not sweet	53.1	.11	7
Rolls, total	20.9	.06	4
Ready-to-eat	13.2	.04	2
Brown and serve	9.2	.03	2
Biscuits, muffins	7.1	.02	1
Cakes	20.1	.11	7
Pies	7.5	.04	2
Other[12]	55.9	.27	17

[9] Includes small amounts of other hot cereals not shown separately.

[10] Includes tapioca, cornstarch barley, buckwheat grits.

[11] Practically all reported as enriched.

[12] Includes cookies, doughnuts, sweet buns, coffee cake, etc.

TABLE XIII.--FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTH CENTRAL REGION OF THE UNITED STATES, 1955--Con.

U. S. Department of Commerce

Food	Households using	Quantity per person	
		In a week	Per day
(1)	(2)	(3)	(4)
	Percent	Pounds	Grams
Eggs	98.6	0.87	56
Meat, poultry, fish, total	100.0	4.37	283
Meat, total	99.9	3.38	219
Beef, total	94.0	1.51	98
Steak, fresh, frozen, total	58.9	.47	31
Round	31.6	.21	14
Other	37.3	.26	17
Roast, fresh, frozen, total	40.9	.44	28
Rib	8.9	.11	7
Other	33.0	.33	22
Stewing, boiling, fresh, frozen	19.7	.12	8
Corned, chipped, dried	9.7	.02	1
Ground, fresh, frozen	68.4	.46	30
Canned (commercial)	2.2	.01	(*)
Veal, total[13]	11.6	.07	5
Roast, shoulder, fresh, frozen	2.6	.03	2
Chops, cutlets, fresh, frozen	7.6	.04	2
Pork, total	91.5	1.23	79
Fresh, frozen, total	63.3	.60	39
Chops	41.5	.24	15
Ham	3.3	.03	2
Loin	11.5	.11	7
Sausage	21.2	.10	6
Other	14.7	.12	8
Cured, smoked, total	80.2	.60	39
Ham, raw, precooked	34.8	.30	19
Bacon	68.5	.25	16
Salt pork	2.4	.01	1
Other	9.5	.05	3
Canned (commercial)	2.7	.02	2
Lamb, mutton, total	7.0	.05	3
Chops, steak, fresh, frozen	4.9	.02	2
Roast, shoulder, leg, fresh, frozen	1.4	.02	1
Stewing, soup, ground, patties	1.1	.01	(*)
Variety meats and game, total	20.6	.10	6
Liver	17.1	.06	4
Other[14]	4.8	.04	2
Luncheon meats, total	74.8	.42	27
Frankfurters	42.8	.16	10
Other, total	63.1	.26	17
Canned	5.0	.01	1
Other	60.6	.25	16
Poultry, total[15]	50.6	.65	42
Chicken[16]	48.8	.59	38
Turkey[16]	2.0	.05	3

[13] Includes small amounts of other veal, not shown separately.

[14] Includes tongue, kidney, heart, tripe, etc.; game.

[15] Includes small amounts of other poultry, not shown separately.

[16] Chiefly fresh or frozen, only small amounts of canned reported.

TABLE XIII.--FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTH CENTRAL REGION OF THE UNITED STATES, 1955--Con.

U. S. Department of Commerce

Food (1)	Households using (2)	Quantity per person	
		In a week (3)	Per day (4)
Meat, poultry, fish—Con.	Percent	Pounds	Grams
Fish and shellfish, total	56.3	0.34	22
Fish, total[17]	53.8	.32	21
Canned (commercial), total	33.1	.08	5
Salmon	12.6	.04	2
Tuna	20.6	.04	2
Other[18]	4.2	.01	(*)
Fresh, frozen	27.5	.24	15
Shellfish, fresh, frozen, canned	6.7	.02	1
Sugar, sweets, total	97.9	1.28	83
Sugar, total	95.5	.86	56
White, total	95.4	.82	53
Granulated	95.0	.75	48
Confectioners, powdered	25.9	.08	5
Brown	21.4	.04	3
Sirups, molasses, honey, total	33.5	.09	6
Sirups, total	26.9	.08	5
Corn, cane	13.1	.04	3
Maple, sorghum, other[19]	15.0	.04	2
Molasses	2.1	(*)	(*)
Honey	8.0	.02	1
Jellies, jams, total	67.6	.19	12
Jellies	39.8	.09	6
Jams, preserves, fruit butters, etc	36.7	.10	6
Candy (commercial), total	43.0	.13	8
With nuts	13.4	.03	2
Without nuts	34.3	.10	6
Potatoes, sweetpotatoes, total	94.9	2.19	142
Fresh, total	94.2	2.09	135
White	93.9	2.05	133
Sweetpotatoes	5.6	.04	2
Frozen[20]	3.5	.01	1
Canned, dehydrated[21]	4.5	.02	2
Potato chips and sticks	26.8	.06	4
Fresh vegetables, total[23]	98.1	2.45	159
Dark green and deep yellow, total[24]	67.5	.37	24
Dark green leafy, total	16.3	.09	6
Spinach	5.9	.02	2
Other	12.5	.06	4
Broccoli	4.4	.03	2
Carrots	57.5	.22	14
Peppers, green	21.2	.03	2

[17] Includes small amounts of smoked, cured fish, not shown separately.

[18] May include small amount of ready-cooked fish, not canned.

[19] See page 52 for chocolate sirup.

[20] Chiefly french fried.

[21] Chiefly canned sweetpotatoes.

[22] Chiefly chips.

[23] Includes home canned and frozen vegetables that were brought into the home in fresh form.

[24] Includes other dark green and deep yellow vegetables not shown separately.

TABLE XIII.–FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTH CENTRAL REGION OF THE UNITED STATES, 1955–Con.

U. S. Department of Commerce

Food (1)	Households using (2)	Quantity per person: In a week (3)	Quantity per person: Per day (4)
	Percent	Pounds	Grams
Fresh vegetables–Con.			
Other green, total	90.2	0.99	64
Asparagus	17.6	.10	6
Beans, snap, wax	23.9	.13	9
Cabbage	35.9	.27	18
Lettuce	80.5	.44	29
Peas	6.2	.03	2
Other	3.6	.02	1
Tomatoes	56.7	.32	21
Other than tomatoes and green and deep yellow, total	90.8	.76	50
Celery	48.3	.14	9
Cucumbers	24.3	.08	5
Mature onions	61.9	.19	13
Green onions	30.0	.07	4
Other, total[25]	50.2	.29	19
Corn	16.4	.11	7
Fresh fruits, total[26]	95.0	3.26	211
Citrus, total[27]	67.0	1.34	87
Grapefruit	28.0	.39	25
Lemons, limes[28]	21.9	.07	5
Oranges	49.9	.88	57
Other than citrus, total[29]	88.9	1.92	125
Apples	46.7	.42	27
Bananas	60.2	.47	30
Melons	10.2	.29	19
Rhubarb	13.8	.09	6
Strawberries	27.3	.30	19
Avocados	3.1	.01	1
Berries other than strawberries	8.1	.05	4
Cherries	7.7	.05	4
Peaches	14.6	.11	7
Other	15.7	.12	8
Commercially frozen fruits and vegetables	33.7	.17	11
Fruits[30]	10.6	.04	2
Vegetables other than potatoes, total	28.4	.13	8
Beans, lima	5.2	.01	1
Beans, snap, wax	6.7	.02	1
Broccoli	6.5	.02	1
Peas	11.2	.03	2
Spinach	5.1	.01	1
Corn	3.9	.01	1
Other	10.6	.03	2

---

[25] Includes beets, cauliflower, turnips, rutabagas, and others not shown separately.
[26] Includes home canned and frozen fruits that were brought into the home in fresh form.
[27] Includes small amounts of tangerines and kumquats not shown separately.
[28] Chiefly lemons.
[29] Includes small amounts of figs and grapes not included in "Other."
[30] Chiefly strawberries.

224<

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTH CENTRAL REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Commerce

Food	Households using	Quantity per person	
		In a week	Per day
(1)	(2)	(3)	(4)
	Percent	Pounds	Grams
Commercially canned fruits and vegetables, total	87.6	1.39	90
Fruits, except baby and junior foods, total	58.2	.48	31
Apples, applesauce	15.7	.07	5
Apricots	6.3	.03	2
Berries	4.6	.02	1
Cherries	8.2	.03	2
Peaches	23.0	.13	9
Pears	11.2	.05	3
Pineapple	19.8	.07	5
Plums, prunes	2.1	.01	1
Mixed fruit, fruit cocktail	11.4	.05	3
Other	4.9	.02	1
Baby, junior foods, incl. juices	8.9	.04	3
Vegetables, except baby and junior foods, total[31]	79.8	.85	55
Asparagus	8.2	.03	2
Baked beans, or other mature beans	17.8	.09	6
Beans, lima, green, immature	4.2	.02	1
Beans, snap, wax	27.7	.13	9
Beets	10.0	.03	2
Corn	36.2	.16	11
Peas, green, immature	36.4	.15	10
Tomatoes, total	22.8	.11	7
Pulp	14.4	.08	5
Puree, paste	11.5	.03	2
Other	32.4	.13	8
Baby, junior foods, incl. potatoes	6.5	.02	2
Fruit and vegetable juices, fresh, frozen, canned, powdered[32, 33]	65.8	1.20	78
Canned citrus, total[32, 34]	24.6	.32	21
Orange	14.6	.21	13
Grapefruit	7.1	.07	5
Canned fruit other than citrus[32]	15.2	.15	10
Canned tomato and other vegetable juices[32, 35]	27.2	.23	15
Frozen, concentrated, total	26.7	.13	8
Orange	24.4	.11	7
Other	5.1	.02	1
Fresh (commercial)	2.8	.04	2
Dried fruits and vegetables, total[36]	36.6	.12	8
Dried fruit, total	21.5	.05	3
Prunes	7.2	.02	1
Raisins, currants	12.1	.02	1
Other	4.9	.01	1

[31] Includes small amount of mature peas not included in "Other."

[32] Single strength equivalent.

[33] Does not include baby or junior juices. See above.

[34] Includes orange and grapefruit blend and other citrus juices not shown separately.

[35] Includes both commercially and home-canned and frozen juices.

[36] Includes both commercially and home-dried fruits and vegetables.

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTH CENTRAL REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Commerce

Food	Households using	Quantity per person	
		In a week	Per day
(1)	(2)	(3)	(4)
	Percent	Pounds	Grams
Dried fruits and vegetables—Con.			
Dry vegetables, total	20.5	0.07	4
Beans, total	18.2	.06	4
Lima	3.4	.01	1
Navy, pinto, kidney, other	15.6	.05	3
Peas, lentils, other	3.1	(*)	(*)
Beverages:			
Coffee, total[37]	94.8	.27	17
Bean, ground	78.9	.25	16
Instant, powdered	23.0	.01	1
Substitute	3.8	(*)	(*)
Tea[38]	20.2	.02	1
Chocolate, cocoa, chocolate sirup, total	27.8	.03	2
Chocolate	7.6	.01	(*)
Cocoa	18.6	.01	1
Chocolate sirup	3.8	.01	1
Soft drinks, fruit ades, total	63.1	.96	62
Soft drinks, bottled and canned, total	55.2	.92	59
Cola-type	34.2	.53	34
Fruit flavored	13.3	.15	10
Other	21.4	.23	15
Powdered	10.6	.01	1
Fruit ades, total	7.5	.03	2
Frozen	4.8	.02	1
Other	2.9	.02	1
Miscellaneous foods:			
Nuts (shelled weight) and peanut butter, total	48.4	.09	6
Nuts (shelled weight), total	21.5	.03	2
Peanuts	7.3	.02	1
Other	15.5	.02	1
Peanut butter	37.3	.06	4
Soups, except canned baby soups, total	48.4	.25	16
Vegetable, total	33.5	.14	9
Condensed	29.6	.13	8
Other	4.2	.01	(*)
Meat, fish, grain, total	29.2	.11	7
Condensed	25.5	.11	7
Other	4.8	.01	1
Catsup, chili sauce, etc., total[39]	58.5	.12	8
Catsup	53.0	.10	6
Chili sauce	5.3	.01	(*)
Barbecue sauce, etc	6.4	.02	1
Tomato relishes	2.1	.01	(*)
Pickles, olives, relishes, total[39]	49.9	.20	13
Pickles	41.6	.17	11
Olives	15.0	.02	2
Relishes other than tomato	6.2	.01	1

[37] Includes small amounts of liquid concentrate coffee, not shown separately.

[38] Data refer to amounts bought during the 7-day survey period rather than the amounts used.

[39] Includes both commercial and homemade products.

TABLE XIII.—FOOD CONSUMPTION PER PERSON IN HOUSEHOLDS IN THE NORTH CENTRAL REGION OF THE UNITED STATES, 1955—Con.

U. S. Department of Commerce

Food	Households using	Quantity per person	
		In a week	Per day
(1)	(2)	(3)	(4)
	Percent	Pounds	Grams
Miscellaneous foods—Con.			
Puddings, pie fillings, miscellaneous sweets (commercial), total[40]	47.4	0.10	7
Puddings, pie fillings[41]	41.8	.06	4
Strained canned puddings (baby)	4.1	.01	1
Sherbets, ices	6.6	.02	2
Icing mix, fudge mix	2.7	.01	(*)
Other mixtures, prepared or partially prepared, total	30.9	.17	11
Mixtures other than baby, junior foods, total	25.8	.13	9
Without meat[42]	10.6	.04	3
With meat[43]	18.4	.09	6
Baby, junior foods, total	7.2	.04	2
Meat, mixtures with meat	6.7	.03	2
Without meat	2.1	.01	(*)
Leavening agents, total[44]	19.9	.03	2
Yeast	11.4	(*)	(*)
Other[44]	9.9	.02	2
Seasonings:[44]			
Vinegar	11.0	.07	4
Salt	20.8	.10	6

[40] Includes other miscellaneous sweets not shown separately.

[41] Chiefly dry, including plain gelatin.

[42] Includes spaghetti with tomato sauce, potato salad, cole slaw, macaroni and cheese dinners, chow mein and chop suey dinners, and others.

[43] Includes poultry and meat pies, spaghetti with meat balls, corned beef hash, chili con carne, ravioli, tamales, and others.

[44] Data refer to amount bought during the 7-day survey period rather than the amounts used.

ANALYTICAL REFERENCE SERVICE

The Public Health Service Robert A. Taft Sanitary Engineering Center conducts an Analytical Reference Service. A summary report of their activities is reproduced below. Inquiries concerning this service should be addressed to Mr. D. G. Ballinger, Acting Chief, Analytical Reference Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

ANALYTICAL REFERENCE SERVICE ACTIVITIES

Robert A. Taft Sanitary Engineering Center
Public Health Service

INTRODUCTION

During the past few years, there has been an increasing need for Federal, State and municipal agencies to assess the radioactivity level in environmental samples such as air, food, vegetation, milk and water. In most cases it is desired to measure first the gross activity of the sample and then, where indicated, the activity of specific radionuclides. The measurement of gross activity is presently complicated by a number of factors such as choice of standards, technique of sample preparation, and type of instrument used for counting.

The Analytical Reference Service is a voluntary association of member organizations responsible for the conduct of laboratory analyses. Included are laboratories of state health departments, state water survey agencies, the larger municipalities, Federal agencies, industries and foreign countries. A list of the current membership is given in Table A-1.

Membership, acquired by written request, imposes no obligation upon the members but is an indication of their desire to participate in the cooperative study of laboratory methodology through the analysis of specially designed samples.

Through its operations, the Analytical Reference Service provides:

1. A statistical evaluation of procedures, including precision and accuracy.
2. An opportunity for a participant to compare his laboratory procedures and results with other laboratories having similar responsibilities.
3. An exchange of information regarding weaknesses of currently approved methods.
4. Evidence regarding methods requiring further development or perhaps entirely new approaches.
5. A framework for broad-scale evaluation of new analytical methods.

PLAN OF OPERATION

Initial efforts in the radiological area have been directed toward the determination of gross radioactivity in water. The scope of this phase of the overall program will be broadened gradually to include other environmental media and the determination of specific radionuclides.

Using standardized radionuclide sources, samples are prepared containing measured amounts of the desired constituent. Decisions as to the qualitative makeup of any particular sample follow suggestions from the members and from the staff of the Sanitary Engineering Center.

After a sample is designed and prepared, a notice announcing its availability and qualitative makeup is sent with a self-addressed reply card to member organizations. An affirmative reply initiates immediate shipment of a portion of the described sample. Results are requested within some reasonable period, usually sixty days.

REPORTING OF RESULTS AND COMMENTS

Data are returned to the Sanitary Engineering Center on forms supplied with the sample. Space is provided on the forms for numerical values and a narrative critique of analytical procedures used.

The results obtained by the cooperating laboratories are compiled in a final report. From examination of the combined data, it is hoped that reliable estimates may be made of the accuracy and precision of the methods employed.

All laboratories are strongly encouraged to supply comments on the analytical methods they use. A complete log of pertinent details, including difficulties, modifications, sources of error, and other factors, is extremely valuable. Such a compilation of comments represents an exchange of ideas and opinions that is a significant part of the final report.

Sample Number One

The first radiological sample prepared by the Analytical Reference Service was natural water, to which had been added a carefully measured amount of the beta emitting radionuclide Thallium-204. For a number of years this nuclide has served as the principal reference source for establishment of the efficiency of counting equipment used in routine water monitoring. The particular objectives of this initial study were set down as follows:

1. How accurately is radioactivity at normal or background levels being determined?
2. What factors affect accuracy?
3. Is there a well-defined need for standardization of sample preparation and counting techniques?
4. Does the type of instrumentation affect the results significantly?

Results of Reports on Sample Number One

Actual concentration of radioactivity in the sample was 5.44 x 10^{-7}uc/ml. The spread in reported concentrations ranged from 0.3 x 10^{-7}uc/ml. to 8.23 x 10^{-7}uc/ml, and only approximately half of the participating laboratories were able to obtain results within 15% of the known concentration.

A number of variables were observed in sample preparation techniques employed by member laboratories. Those principally affecting the results were:

1. Sample Temperature of Drying
2. Type of Counting Instrument
3. Standard Used in Calibrating Counting Equipment
4. Volume of Sample.

A summary of the results on this sample is shown in Table A-2.

Sample Number Two

In the preparation of a second sample, an attempt was made to eliminate certain of the variables noted in the initial study. This was done by suggesting the sample volume to be used and general preparation procedures to be followed.

The radionuclide used in the preparation of Sample Number Two was cesium-137. The use of Cs^{137} was suggested by members of the staff of the Analytical Chemistry Division at the Oak Ridge National Laboratory. This radionuclide (and its daughter, Ba^{137m}) emits gamma as well as beta radiation, and has a long half-life--two features which make it rather ideal for purposes of a study of this type.

Results of Reports on Sample Number Two

The standardization concentration in the sample was 6.7 x 10^{-7}uc/ml as beta activity and 5.0 x 10^{-7}uc/ml as gamma activity. Although the spread in data was just as great as for Sample Number one, in general the results reflected improvement, as shown in Table A-2. Preliminary evaluation indicates that, of 42 participating laboratories, over one-half reported concentrations within ±15% of the known amount, while almost 75% were within ±25%. These data are currently being analyzed more in detail and a final report will be issued by the Sanitary Engineering Center within the next six months.

COUNTING STANDARDS

Because a number of the laboratories participating in the study on Sample Number Two have requested assistance in the calibration of their counting equipment, the Analytical Reference Service has recently prepared standard solutions of Cs^{137} for their use. Using these solutions, each laboratory will be able to prepare a series of calibrated samples which should enable them to obtain accurate data on the self-absorption and efficiency characteristics of typical samples counted using their present equipment. This, in turn, should lead to more accurate data submitted during future studies of this type and in the data being obtained by these laboratories on environmental samples.

COMMENTARY

On the basis of the two radiological samples studied to date, it would appear that the participating laboratories, as a group, are improving in the field of radiological examination of water for gross activity. However, much work still remains to be done. This includes not only the selection and preparation of counting standards but also the preparation and counting of the samples themselves.

Once gross measurements in water assume an acceptable degree of accuracy, specific radionuclide determinations will be investigated and, at the same time, these studies will be extended to include other environmental media.

229-

TABLE A-1

ANALYTICAL REFERENCE SERVICE MEMBERS AS OF MAY 1, 1960

State Agencies

Alabama Water Improvement Commission
Arizona State Department of Health
Arkansas State Board of Health
California State Department of Public Health (Berkeley)
California State Department of Public Health (Los Angeles)
California Department of Water Resources
Connecticut State Department of Health
Florida State Board of Health
State of Hawaii Department of Health
Idaho State Board of Health
Illinois State Department of Public Health (Chicago)
Illinois State Department of Public Health (Springfield)
Illinois State Water Survey Division
Kentucky State Department of Health
Louisiana State Health Department
Maryland State Department of Health
Maryland State Water Pollution Control Commission
Michigan State Department of Health
Minnesota State Department of Health
Missouri Department of Public Health & Welfare
Montana State Board of Health
Nebraska State Department of Health
New Hampshire Water Pollution Commission
New Jersey Department of Health
New Mexico State Department of Public Health
New York State Department of Health
New York State Conservation Department
North Carolina State Board of Health
Ohio State Department of Health
Oregon State Board of Health
Pennsylvania Department of Health
State of Rhode Island and Providence Plantations
South Carolina Water Pollution Control Authority
South Dakota Department of Health
Tennessee Stream Pollution Control Board
Texas State Department of Health
Utah State Department of Health
Vermont State Department of Health
Vermont State Water Conservation Board
Virginia State Health Department
Virginia State Water Control Board
Washington State Department of Health
West Virginia State Water Commission
Wisconsin State Board of Health

Municipal Agencies

Metropolitan Water District of Southern California
Los Angeles Department of Water and Power
Los Angeles County Flood Control District
Chicago Department of Water and Sewers
Flint Department of Public Works and Utilities
Dayton Department of Service and Buildings
Philadelphia Suburban Water Company
Philadelphia Water Quality Control and Research Division
St. Louis County Water Company

Federal Agencies

Tennessee Valley Authority, Wilson Dam, Ala. (Lab I)
Tennessee Valley Authority, Wilson Dam, Ala. (Lab II)
Tennessee Valley Authority, Chattanooga, Tenn.
U. S. Army Environmental Health Laboratory, Army Chemical Center, Md.
Sanitary Engineering Division, 13th Naval District, Seattle, Wash.
U. S. Dept. of the Interior, Geological Survey, Sacramento, Calif.
U. S. Dept. of the Interior, Geological Survey, Denver, Colo.
U. S. Dept. of the Interior, Bureau of Reclamation, Denver, Colo.
U. S. Dept. of the Interior, Geological Survey, Columbus, Ohio
U. S. Dept. of the Interior, Geological Survey, Philadelphia, Pa.
U. S. Dept. of the Interior, Geological Survey, Washington, D. C.

Universities

Georgia Institute of Technology, Dept. of Applied Biology
Purdue University, Department of Chemistry
Rutgers University, Department of Sanitation
Case Institute of Technology, Dept. of Civil and Sanitary Engineering
University of Pittsburgh, Graduate School of Public Health

Industry

American Cyanamid Company
California Water Service Company (San Jose)
Central Farmers Fertilizer Company
Dearborn Chemical Company
Ekroth Laboratories, Inc.
Food Machinery & Chemical Corporation
Goodyear Atomic Corporation
Monsanto Chemical Company
National Aluminate Corporation
Sandia Corporation

Foreign

Department of National Health and Welfare (Vancouver, B. C.)
Department of National Health and Welfare (Ottawa, Ontario)

230<

TABLE A-2

COMPARISON OF DATA ON RADIOLOGICAL SAMPLES NO. 1 AND NO. 2

Percent spread from actual value	Sample No. 1 (Tl^{204}) (26 laboratories reporting)			Sample No. 2 (Cs^{137}) (42 laboratories reporting)		
	Spread $\mu c/ml \times 10^{-7}$	Number of results in each spread	Percent of total number of results	Spread $\mu c/ml \times 10^{-7}$	Number of results in each spread	Percent of total number of results
± 10%	4.90-5.98	8	31%	6.03-7.37	18	43%
± 25%	4.08-6.80	16	62%	5.02-8.38	32	76%
± 50%	2.72-8.16	20	77%	3.35-10.05	38	90%
± 75%	1.36-9.52	23	88%	1.68-11.72	41	98%

USCOMM—DC

231<